

SPEECH MONOGRAPHS

VOLUME VIII

RESEARCH ANNUAL

DECEMBER, 1941

GRADUATE THESES—AN INDEX OF GRADUATE WORK IN THE FIELD OF SPEECH—VII*

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SECTION I

A TOTAL of 407 graduate degrees are reported in this edition of the series. Of this total 190 are Masters' degrees granted with requirement of thesis, 185 are Masters' degrees granted without requirement of thesis, and 32 are Doctors' degrees. The record of graduate degrees now granted in the field of speech and dramatic art include 1,607 Masters' degrees with thesis, 1,583 Masters' degrees without requirement of thesis, and 198 Doctors' degrees for a grand total of 3,388 degrees.

Table I records the institutional sources of graduate school degrees in this field, with separate tabulations of the degrees granted in 1940 and in total, and of the various levels of graduate degrees. Of the 35 institutions which have granted graduate speech degrees, 26 granted degrees in 1940. Institutions reported for the first time in this record include the University of Oklahoma and the University of Hawaii. The University of Michigan began granting Masters' degrees with requirement of thesis, and the University of Minnesota granted its first doctorate in speech during 1940.

The number and percentages of the total number of degrees granted each year are indicated in Table II. There was a definite increase in the total number of both Masters' and Doctors' degrees granted during 1940. Eighty-two percent of the Masters' and ninety percent of the Doctors' degrees have been granted during the last ten years.

*The continued publication of this series is made possible through the cooperation of speech and dramatics departments in the graduate schools involved. The writer gratefully acknowledges his indebtedness to the department administrators in these schools for supplying these data.

Rough classifications of the subject matter areas to which studies were devoted are presented in Table III. An increase in the percentage of doctorate degrees in dramatics and in education is indicated.

TABLE I
INSTITUTIONAL SOURCES OF DEGREES GRANTED
(1940 Degrees in Parentheses)

	MASTERS' DEGREES			DOCTORS' DEGREES	COM- BINED TOTAL
	With Thesis	Without Thesis	Total		
Akron.....		2	2		2
Alabama.....	(2)	6	(1) 1		7
Brooklyn.....		14	14		14
Carnegie.....		11	11		11
Columbia—T. C.....		3	(50) 659	(3) 21	683
Cornell.....	(15)	105	105	(3) 24	129
Denver.....	(8)	38	38		38
George Washington..		2	2		2
Grinnel.....		1	1		1
Hawaii.....	(2)	2	2		2
Illinois.....	(1)	5	5		5
Indiana.....	(3)	5	5		5
Iowa.....	(50)	415	415	(3) 48	463
Louisiana.....	(10)	61	61	(2) 12	73
Marquette.....	(3)	23	23		23
Michigan.....	(9)	9	(39) 439	(5) 22	470
Minnesota.....	(2)	41	(1) 5	(1) 1	47
Missouri.....	(3)	6	6		6
New Mexico Normal..		8	8		8
Northwestern.....	(5)	244	(42) 104	(3) 7	355
Ohio State.....	(7)	33	33	2	35
Ohio University.....	(2)	6	6		6
Ohio Wesleyan.....		26	26		26
Oklahoma.....	(3)	3	3		3
Purdue.....		5	5		5
South Dakota.....	(1)	3	3		3
Southern California..	(4)	150	(38) 225	(6) 12	387
Stanford.....		21	21	1	22
Syracuse.....	(3)	8	8	1	9
Utah.....	(2)	17	17		17
Washington, Univer- sity of.....	(4)	20	20		20
Wayne.....	(7)	29	(3) 9		38
Western Reserve.....		1	(11) 65		66
Wisconsin.....	(29)	242	242	(5) 42	284
Yale.....	(15)	42	76	(1) 5	123
Grand Totals....	(190)	1,607	(185) 1,583	(32) 198	3,388

Section II of the report contains a list of theses titles classified by institution and type of degree granted, and arranged alphabetically by thesis author's name within the year. The titles are given numbers in sequence from the last published list, beginning with number 1584 and extending to number 1805. Section III contains an index of the titles classified on the basis of the six major academic areas in the field. Doctorate dissertations are designated in

this index by an asterisk following the number. Titles are listed with cross references in more than one area where such overlapping is suggested by the title. The last lines of the index are devoted to the thesis index numbers listed in sequence by the institutions granting the degrees.

TABLE II
NUMBER OF DEGREES GRANTED WITH AND WITHOUT THESIS TABULATED BY YEAR

YEAR	MASTERS' DEGREES				DOCTORS' DEGREES	
	With Thesis	Without Thesis	Total	Percent of Total	Number	Percent
1902.	1		1	.03134		
1903.	1		1	.03134		
1904.	1		1	.03134		
1906.	1		1	.03134		
1907.	1		1	.03134		
1908.	3		3	.09404		
1909.	1		1	.03134		
1912.	1		1	.03134		
1913.	1		1	.03134		
1917.	1		1	.03134		
1918.	1	1	2	.06269		
1920.	3	1	4	.12539		
1921.	2		2	.06269		
1922.	7	1	8	.25078	1	.50505
1923.	9	3	12	.37617		
1924.	19	6	25	.78369		
1925.	28	16	44	1.37931		
1926.	37	18	55	1.72413	3	1.51515
1927.	43	19	62	1.94357	1	.50505
1928.	38	25	63	1.97492	5	2.52525
1929.	88	40	128	4.01253	4	2.02020
1930.	79	66	145	4.54545	6	3.03030
1931.	113	53	166	5.20376	2	1.01010
1932.	96	101	197	6.17554	11	5.55555
1933.	84	128	212	6.64576	8	4.04040
1934.	78	153	231	7.24137	7	3.53535
1935.	104	113	217	6.80250	14	7.07070
1936.	122	142	264	8.27586	21	10.60606
1937.	131	170	301	9.43573	28	14.14141
1938.	172	171	343	10.75235	28	14.14141
1939.	151	171	322	10.09404	27	13.63636
1940.	190	185	375	11.75548	32	16.16161
Totals.	1,607	1,583	3,190	99.99982	198	99.99995

TABLE III
THESES CLASSIFIED BY SUBJECT MATTER

		PREVIOUS LISTS	NEW LIST	TOTAL
Fundamentals.....	Masters'—Number	170	30	200
	Percent	12.00	15.79	12.45
	Doctors'—Number	41	5	46
	Percent	24.70	15.63	23.23
Public Speaking.....	Masters'—Number	223	26	249
	Percent	15.74	13.68	15.49
	Doctors'—Number	50	10	60
	Percent	30.16	31.25	30.30
Oral Reading.....	Masters'—Number	56	5	61
	Percent	3.95	2.63	3.80
	Doctors'—Number	1		1
	Percent	.60		.51
Dramatics.....	Masters'—Number	570	81	651
	Percent	40.22	42.63	40.51
	Doctors'—Number	27	9	36
	Percent	16.23	28.13	18.18
Speech Defects.....	Masters'—Number	125	21	146
	Percent	8.82	11.05	9.09
	Doctors'—Number	20	2	22
	Percent	12.05	6.25	11.11
Education.....	Masters'—Number	254	27	281
	Percent	17.93	14.21	17.49
	Doctors'—Number	23	6	29
	Percent	13.85	18.75	14.65
Miscellaneous.....	Masters'—Number	19		19
	Percent	1.34		1.18
	Doctors'—Number	4		4
	Percent	2.41		2.02

SECTION II

TITLES

UNIVERSITY OF ALABAMA
1940

M.A. Theses

1584. Jones, Georgia Lee, Classification and Evaluation of the Theories of the Origins of Speech.
1585. Porter, William Earl, The Realism of Sidney Howard.

COLUMBIA UNIVERSITY
Teachers College
1940

Ph.D. Theses

1586. Hamilton, Portia G., The Visual Characteristics of Stutterers During Silent Reading.

1587. Morgan, Rita, Arbitration in the Men's Clothing Industry in New York City.

Ed.D. Thesis

1588. Parsons, Robert R., Speech Education in the Elementary School.

CORNELL UNIVERSITY

1940

M.A. Theses

1589. Boyle, Walden Philip, The Décor of the French Symbolist Theater and Its Influences.
1590. Eaker, Susan, Steele and Percy MacKaye. Their Theories and Practice in the Theatre.
1591. Gaupp, Charles John, Jr., John Dryden: His Theory and Practice of the Drama.
1592. Gordon, Elizabeth Mary, Principles of Oral Style.
1593. Hawes, David Stewart, Theodore Komisarjevsky's Theory of the Theatre.
1594. Herod, John Blaker, The Unit Set.
1595. Hodge, Francis Richard, Theatrical Management in America in the Nineteenth Century.
1596. Howard, Angela Alison, Thomas Rymer: His Criticisms of Shakespeare and Their Influence on Drama.
1597. LePage, Elizabeth, Methods of Production for Greek Plays.
1598. Marx, George Edwards, Essay: Henry Fielding and His Place in the Theatre.
1599. Masterson, Reba Ella, On the Actor's Art: An Annotated Translation of Talma's *Sur L'Art du Comédien*.
1600. O'Neil, Marion Rose, The Opinions of Ancient Rhetoricians Concerning the Audience.
1601. Thompson, Frances Ruth, English Drama Between 1900-1918.
1602. Wilburn, Elizabeth Eleanor, American Theatre Buildings in the Eighteenth Century.
1603. Williams, Lauren Robert, Censorship in State and Cinema.

Ph.D. Theses

1604. Ernst, Earle, Cycles in the Development of the Dramatic Art.
1605. Lewis, John Colby, A Correlation of the Theatre with the Graphic Arts, According to the Dominant Artistic Theories of Several Times, from the Middle Ages to the Present Day.
1606. Wilson, Garff Bell, American Styles and Theories of Acting from Edwin Forrest to David Belasco.

UNIVERSITY OF DENVER

1940

M.A. Theses

- 1607. Auston, John T., Edward P. Costigan's Theory and Style of Speaking.
- 1608. Crowley, Elmer, The History of the Tabor Grand Opera House, Denver, Colorado, 1881-91.
- 1609. Fowlkes, Virginia, *Dried Out*, an Original Play, Based on Materials from Eastern Colorado.
- 1610. Larson, Harry P., The Effect of Speech on the Inter-Personal Relationships of College Students.
- 1611. Leadbetter, Dorothy C., *Between Friends*, an Original Play.
- 1612. Pearson, Gerald, A Study of Semantics as a Cause of Court Cases.
- 1613. Perry, C. Evelyn, *Erosion*, An Original Play Based on Materials from Western Kansas.
- 1614. Van Metre, Jessie M., A Comparison of the Eye-movements of Good and Poor Oral Readers.

UNIVERSITY OF HAWAII

1940

M.A. Thesis

- 1615. Orne, Carol, Consistency and Objectivity in Judging Speech Sounds.

M.Ed. Thesis

- 1616. Okawa, Sumi, A Study of the Pronunciation of the Various Spellings of Vowels, Diphthongs, and Triphthongs in Stressed and Semi-stressed Syllables.

UNIVERSITY OF ILLINOIS

1940

M.A. Thesis

- 1617. Wilson, Howard Woodrow, Some Implications of Dewey's Philosophy for the Teaching of Speech.

INDIANA UNIVERSITY

1940

M.A. Theses

- 1618. Blair, George Franklin, An Analysis of All the Successful Plays Presented on Broadway from the 1919-20 Season through the 1938-39 Season for the Purpose of Determining Specific Trends of Playwright Thought Regarding Family Organization as Basic Material for Conflict in Dramatic Composition.

- 1619. Hudelson, Ben Andrew, A Critical Analysis of the Contribution of George S. Kaufman to the American Theatre from 1921-1940.
- 1620. Roe, Vivian Irene, The Effect of Maturation upon Defective Articulation in the Elementary Grades.

STATE UNIVERSITY OF IOWA

1940

M.A. Theses

- 1621. Adams, Minnie Harris, A Survey of the General Characteristics of Southern American Dialects.
- 1622. Arnold, Carroll Clyde, The Speech Philosophy of Benjamin Disraeli.
- 1623. Bebout, Nancy Elizabeth, An Objective Study of the Movements and Dimensions of the Peripheral Oral Structures, I.
- 1624. Becker, Joseph Frederick, An Actor's Preparation and Interpretation of Two Important Comedy Roles in the Theatre.
- 1625. Bogen, Paul Logasa, Diagnostic Studies of Abilities of Students in Dramatic Art. V.
- 1626. Brennen, Dorothy Marie, A Director's Plans and Promptbook for Tom Taylor's *Ticket of Leave Man*.
- 1627. Byers, Burton Holmes, An Evaluation of Scripts for High School Broadcasts.
- 1628. Crowell, Laura Irene, An Evaluation of Logical, Ethical and Pathetic Proof in Selected Speeches by Woodrow Wilson on International Peace.
- 1629. Curtis, James F., A Study of the Effect of Muscular Exercise upon Stuttering.
- 1630. Dale, Hazel Genevieve, Experimental Study of the Audience Reactions to Different Degrees of Illumination Applied to Specific Scenes from Plays.
- 1631. Darley, Frederic Loudon, A Normative Study of Oral Reading Rate.
- 1632. Eaves, Ellen, Diagnostic Studies of Abilities of Students in Dramatic Art. I.
- 1633. Enstrom, Ralph Edmund, A Study of the Factors and Influence in the Training and Education of Wendell Phillips Accounting for his Later Ability as an Orator.
- 1634. Evans, Marguerite S., An Analysis of Four Textbooks in Dramatic Art for Secondary Schools.
- 1635. Frasier, Jeannette, A Study of Stutterers' Theories of Their Own Stuttering.

1636. Frederick, Robert Lee, A Producing Director's Study of Sheridan's *School for Scandal*.
1637. Grant, David M., Factors and Influences in the Training and Education of Rufus Choate Accounting for His Later Effectiveness as a Speaker.
1638. Gray, Marcella Elizabeth, The X Family: A Laboratory and Clinical Study of a "Stuttering" Family.
1639. Green, Evelyn Mabel, An Objective Study of the Movements and Dimensions of the Peripheral Oral Structures, II.
1640. Hansen, Malvin Lloyd, An Evaluation of the Arguments of Calhoun on Foreign Affairs.
1641. Hardin, Mary Evelyn, A Director's Study and Promptbook for T. W. Robertson's *Caste*.
1642. Harris, William Edward, A Study of the Adaptation Effect in Stuttering.
1643. Hearn, Guy Edward, An Experimental Study of the Efficiency and Adaptability of Fresnel Lenses.
1644. Hickok, Benjamin Blakely, A Director's Study and Designs for a Production of Tom Tayler's *Our American Cousin*.
1645. Holmes, Olivette Arlene, A Comparative Study of Early and Recent Textbooks in Interpretative Reading.
1646. Jackson, Marjorie Mae, Experimental Production of Three Original One Act Plays.
1647. King, Robert, Daniel Webster's Western Tour of 1837—a Critical Examination of His Speeches and Speech Techniques.
1648. Kohlmeier, Margaret E., An Analysis and Plans for the Reconstruction of the Roman Theater at Aspendus.
1649. Kuney, Clark Glamis, An Experiment to Determine the Influence of Colored Light on Audience Reaction to Scenes from Plays.
1650. Lamb, Arthur Clifton, Experimental Production of an Original Long Play.
1651. Lester, Marjorie Lois, A Descriptive Analysis of the Changes in the Use of Language in Original and Printed Versions of Selected University of Chicago Round Table Discussions.
1652. LeVander, Theodor, A Critical Evaluation of Dr. Fosdick's Radio Address on "National Vespers" for the Season 1939-40.
1653. McAlear, Kathleen E., Producing Director's Study of Gilbert's *Engaged*.

- 1654. Marsh, Jane Wellington, Experimental Production of an Original Three-Act Play.
- 1655. Mitchell, Edward R., Design Project for Emile Verhaeren's *The Dawn*.
- 1656. Mstrom, Vincent Gerhard, A Critical Study of Franklin D. Roosevelt's Neutrality Speeches of September, 1939.
- 1657. Pross, Edward Lawrence, A Critical Analysis of Two Representative Speeches of Theodore Roosevelt, the Progressive.
- 1658. Raike, Anna C., Diagnostic Studies of Abilities of Students in Dramatic Art, III.
- 1659. Sipin, Laura, A Comparative Analysis of the Phonetic Systems of Certain European Languages.
- 1660. Spriestersbach, D. Caryl, An Objective Study of the Dimensions and Movements of the Peripheral Oral Structures, III.
- 1661. Stewart, Caroline Hill, An Actress' Preparation and Interpretation of Three Widely Different Major Roles in the Theatre.
- 1662. Stice, Cora Evelyn, Producing Director's Study of Goldsmith's *Good-Natured Man*.
- 1663. Swanson, Ila Harris, A Method of Supervising Speech Improvement in the Lower Elementary Grades.
- 1664. Van Arsdale, Ronald Albert, A Producing Director's Study of John Gay's *Beggars' Opera*.
- 1665. Van Horn, Mary Helen, An Objective Study of the Dimensions and Movements of the Peripheral Oral Structures, IV.
- 1666. Wagner, Lillian Rose, A Series of Radio Scripts for the Iowa State Teacher's Association Based on Principles of the Educational Policies Commission.
- 1667. Wentworth, Edith Titcomb, A Survey of Methods for the Improvement of Pitch Usage in Speech as Presented in Twenty-five Current Speech Texts.
- 1668. Wible, Josephine Elizabeth, The Use of Climax in Sixty-one Performances of One-Act Plays Produced by High Schools.
- 1669. Woodhouse, Marianne, Staff and Organization of Small Radio Stations.

M.F.A. Thesis

- 1670. Forsythe, Henderson, An Actor's Preparation and Interpretation of Three Widely Different Major Roles in the Theatre.

Ph.D. Theses

- 1671. Abernathy, Elton, An Analysis of Trends in American Homiletic Theory Since 1860.

- 1672. Paul, Wilson Benton, John Witherspoon's Theory and Practice of Public Speaking.
- 1673. Snidecor, John Clifton, Experimental Studies of the Pitch and Duration Characteristic of Superior Speakers.

LOUISIANA STATE UNIVERSITY

1940

M.A. Theses

- 1674. Drake, Norbert, An Analysis of the Senatorial Speaking of Benjamin R. Tillman.
- 1675. Faxon, Glen S., A Survey of General Semantics.
- 1676. Galloway, William F., An Analysis of the Critical Reviews of Justin Brooks Atkinson for the Years 1930-1940.
- 1677. Gamewell, Dorothy Allen, The Mid-Century Little Theatre in the Light of Pre-War Idealism; A Comparative Study.
- 1678. Huckleberry, Alan W., John C. Breckinridge, a Kentucky Orator.
- 1679. Levy, Edwin L., Delsarte's *Cours d'Esthétique Appliquée*, Based on an Original Notebook.
- 1680. Marsh, Harold, An Analysis and Criticism of the Senatorial Speaking of Sam Houston.
- 1681. Perry, Louise S., A Study of the Pronoun *Hit* in Grassy Branch, North Carolina.
- 1682. Stovall, Thera N., Quintillian's Methods of Teaching Speech Compared with Those of Selected Modern Speech Teachers.
- 1683. Womack, Alma Belle, Drill Book in Southern Pronunciation for Intermediate Grades.

Ph.D. Theses

- 1684. Lynn, Klonda, A Phonetic Analysis of the English Spoken by Mexican Children in the Elementary Schools of Arizona.
- 1685. Plummer, Robert N., Comparison of Auditory Acuity to Pure Tones and the Ability to Discriminate among English Consonants.

MARQUETTE UNIVERSITY

1940

M.A. Theses

- 1686. Michaela, Sister M. (Fuchs), Suggested Procedure for Integrating Speech with Subjects Taught in the Fourth Grade.
- 1687. Jean, Sister M. (Schwalbach), Motor Aphasia; A Case Study.

1688. Sherkow, Vernon A., The Use of Psychiatric Methods in Speech Correction.

UNIVERSITY OF MICHIGAN

1940

M.A. Theses

1689. Beglinger, Cecil Adele, A Gentleman and an Actor (Otis Skinner).
1690. Carruth, Elizabeth, A Panoramic View of the Status of the Theatre.
1691. Dolch, Catherine., A History of Stage Lighting to 1880.
1692. Dunshee, Grace, Inigo Jones.
1693. Klein, Arthur, A Study of Eugene O'Neill's Early Plays.
1694. Michlinski, Florence E., Organismic Development in Speech Defective Children.
1695. Paprin, Eugenia, The Preparation, Presentation, and Follow-Up Activities of Radio in the Classroom.
1696. Partridge, A. E., Emerson and Woolbert.
1697. Rose, Jeannette, Maude Adams, Her Life and Career.

Ph.D. Theses

1698. Crandall, Frederic O., Three Studies in Propaganda in the American Theater.
1699. McGaw, Charles J., An Analysis of the Dramatic Criticism of William Winter.
1700. Pierce, L. Adeline, Rhythm in Literature Parallels the Scale of Specificity of Speech Development: A Biolinguistic Study.
1701. Weller, Herbert C., Vegetative Rhythm Determinative of Speech Patterns.

Sc.D. Thesis

1702. Ross, Hattie Bell, Dietary Consistency and Habits and Effective Nutritive Processes in Their Relationship to the Development of Specificity, Including Speech.

UNIVERSITY OF MINNESOTA

1940

M.A. Theses

1703. Moren, Adelaide, The Frequency of Stuttering in Relation to Word Length during Oral Reading.
1704. Shulman, Edward E., A Study of Intra-Muscular Pressure in Stutterers and Non-stutterers.

Ph.D. Theses

1705. Ramsland, Clement, Whig Propaganda in the Theatre. 1700-1742.

UNIVERSITY OF MISSOURI

1940

M.A. Theses

1706. Bidstrup, Dudley June, Public Speaking in Missouri 1840-1860.
 1707. Hugo, John David, Milton's Rhetoric in Satan's Speeches.
 1708. Seelen, William Earl, A Rhetorical Criticism of Thomas Hart Benton's Expunging Speech.

NORTHWESTERN UNIVERSITY

1940

M.A. Theses

1709. Andersen, Lillian, An Interpretative Study of the Character of Lady Macbeth in William Shakespeare's Tragedy, *Macbeth*.
 1710. Brackett, Isaac, A Study of the Growth of Inflammation of the Vocal Folds Accompanying Easy and Harsh Production of the Voice.
 1711. Brain, Geraldine, Writing, Directing and Producing *Marco Polo*, a Three Act Play for Children.
 1712. Phelps, George Baldwin, *Paola and Francesca*.
 1713. Reed, Ernest Harold, Free-State Oratory in Kansas Territory, 1854-1859.

Ph.D. Theses

1714. Guthrie, Warren Alan, The Development of Rhetorical Theory in America, 1635-1850.
 1715. Lomas, Charles W., An Experimental Study of Some of the Effects of Provocative Language on Audience Reaction to Political Speeches.
 1716. Robinson, Karl Frederic, An Experimental Study of the Effects of Group Discussion upon the Social Attitudes of College Students.

OHIO STATE UNIVERSITY

1940

M.A. Theses

1717. Brilty, Francis Xavier, Influence of Parental Age at Conception on a Child's Genic Stuttering Predisposition.

- 1718. Farley, Perl Howard, Edward Gordon Craig: Theories of Drama.
- 1719. George, Ramon Thomas, A Study of Speech Fricative Air Pressure.
- 1720. Irwin, John Valeur, A Study of Relationships between Certain Laryngeal Mechanisms and Voice Pitch.
- 1721. Poston, Don Harold, Edwin Booth, the Actor.
- 1722. Russell, Ruth Lillian, Acting Techniques in America from 1880-1890.
- 1723. Shultz, Dorothy Grace, Status of Speech Education in the Secondary Schools of the Northeast Educational District of Ohio.

OHIO UNIVERSITY

1940

M.A. Theses

- 1724. James, Genevieve C., A Check Sheet for High School Auditorium Stages.
- 1725. Matthews, Jack, Trends in General Semantic Studies 1850 to 1940 with Emphasis on the Modern Period.

UNIVERSITY OF OKLAHOMA

1940

M.A. Theses

- 1726. Cromwell, Harvey, An Objective Study of the Speaking Methods of William Henry David Murray.
- 1727. McCullough, Effie Laura, A Critical Study of the Pronunciation of the Elementary Teachers of Oklahoma.
- 1728. Woods, Halcy G., Remedial Procedures for the Hard-of-Hearing in Colleges and Universities.

UNIVERSITY OF SOUTH DAKOTA

1940

M.A. Thesis

- 1729. Nelson, A. Ellen, An Evaluation of American Folk Play Material.

UNIVERSITY OF SOUTHERN CALIFORNIA

1940

M.A. Theses

- 1730. Adkins, Iva Verlea, *From Out That Shadow* (three-act play based on the life of Edgar Allan Poe).

- 1731. Crawford, Josephine Ruth, The Acting Technique of Minnie Maddern Fiske.
- 1732. Goff, Lilyan Zara, Development of the Theatre on the American Frontier.
- 1733. Sutter, Margaret Elizabeth, Behavior Problems of Children with Delayed Speech.

Ph.D. Theses

- 1734. Beckey, Ruth Elizabeth, A Study of Certain Factors Related to the Retardation of Speech.
- 1735. Brewster, Harold Leland, An Objective Study of the Oratory of Robert Green Ingersoll.
- 1736. Cross, Henry Norman, A Study of the Thinking-Feeling-Doing Trichotomy: Its Application in the Field of Speech.
- 1737. Freed, Conrad W., The Role of Speech in the Educative Process.
- 1738. Hirt, Anne Louise, The Place of Georg II, Duke of Meiningen, in the Unfoldment of Theatre Art.
- 1739. Myers, Chester J., A Critical Analysis and Appraisal of the Work of Brigham Young as a Public Speaker.

SYRACUSE UNIVERSITY

1940

M.A. Theses

- 1740. Daniels, Elizabeth, An Analysis of the Relations Between Handedness and Stuttering with Special Reference to the Orton-Travis Theory of Cerebral Dominance.
- 1741. McEvoy, J. Edward, An Experimental Study of the Process of Group Discussion in Small Groups.
- 1742. Robinson, Zon, A Study of the Accuracy with Which Speeches Are Recorded in the *Congressional Record*.

UNIVERSITY OF UTAH

1940

M.A. Theses

- 1743. Richards, Clara, Elements of Persuasion Used by St. Paul Based on the King James Translation of the Bible.
- 1744. Wilcox, LeRoy Clark, Shakespeare's Contribution to the Exemplification of the Principles of Effective Speaking.

UNIVERSITY OF WASHINGTON

1940

M.A. Theses

1745. Hoshor, John Payton, A Study of the Principles of Ethical Proof in the Works of Certain Ancient and Modern Rhetoricians.
1746. Long, Eva Ansted, A Survey and Comparison of Speech Defects in Three Public Grade Schools of Seattle, Washington.
1747. McCrery, Lester Lyle, Persuasive Methods of Franklin Delano Roosevelt in Certain Speeches of the 1932 Presidential Campaign.
1748. Rasmus, Ward Thorval, The Influence of Palatal Deviations and Dental Malocclusions on the Production of Consonant Sounds.

WAYNE UNIVERSITY

1940

M.A. Theses

1749. Davis, Reginald, A Survey of the Radio Listening Preferences of the Students of Fordson High School and Junior College and Comparison with the Listening Preferences of Adults.
1750. Goldman, Miriam, A Suggested Outline for a Course of Training in Speech for the Prospective Elementary Teacher.
1751. Kursman, Shirley, A Study of the Speech Test and Remedial Procedures in Use at Wayne University.
1752. Mackin, Edward, The Status of Speech Education in Michigan.
1753. Nottingham, Ralph, The Application of Student Participation to the Teaching of Radio as Exemplified by Teacher Training at Wayne University.
1754. Rodriguez, Alfonzo, The Philosophy of a Fundamentals Course in Speech.
1755. Sauble, Elizabeth, Director's Prompt Book of Richard B. Sheridan's *The Critic*, as Produced by the Student Stage of Wayne University, with an Introductory Study of Sheridan's Life and Works.

UNIVERSITY OF WISCONSIN

1940

M.A. Theses

1756. Anderson, Jeanette Olive, A Study of Blood-Group Distribution among Stutterers.

- 1757. Beeken, Arthur H., A Study of Gerhart Hauptmann's *The Sunken Bell*.
- 1758. Browne, Charles T., The Relative Effectiveness of Long and Short Sentences in Informative Speeches.
- 1759. Burr, Leona Lloyd, Fashions in the Use of the Supernatural in Tragedy, 600 B.C. to 1616.
- 1760. Chamberlain, Harold, A Comparison of Authoritative Opinions in the Fields of Song and Speech on Twelve Vocal Criteria.
- 1761. Cook, Mabel Louise, Significant Implications for the Interpreter in the Writings of James Russell Lowell and Amy Lowell.
- 1762. Dana, Charlotte Elizabeth, A Comparative Study of the Western Electric and Sonotone Audiometers.
- 1763. Dietrich, John Erb, The Effect of Participation in Extra Curricular Dramatics upon Scholarship Achievement.
- 1764. Fontaine, Virginia Elizabeth, The Auditory Memory Span of Children for Vowel Sounds.
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- 1780. Smith, Dean Bailey, Rate and Variation in Rate in Selected School Broadcasts.
- 1781. Stachowiak, Ray John, The Relationship Between Change in Attitudes and the Ability to Reevaluate Arguments.
- 1782. Whealdon, Mary Lawton, A Study of Blood-Group Distribution Among Stutterers.
- 1783. Word, Sarah Helen, The Acting Technique of Helen Hayes with Reference to the Broadway and Stanislavski Systems as Practiced in America.
- 1784. Zimmerman, Bettye Janet, Study of Visual Symbolization, Construction of a Preliminary Test of the Faculty of Association Between a Spoken Word and a Visual Symbol.

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- 1786. Kaump, Ethel Amelia, An Analysis of the Structural Differences Between the Oral and Written Language of One Hundred Secondary School Students.
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- 1792. Elwell, Merwin Macy, A Design Project for *L'Amore Dei Tre Re* by Sam Bennelli.

- 1793. Gnau, Margaret Strauss, A Production of *The Beaux Strata-*
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- 1795. Karch, Mildred Annamarie, A Production of *Stage Center*
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Illinois, University of	1617
Indiana University	1618—1620
Iowa, State University of	1621—1673
Louisiana State University	1674—1685
Marquette University	1686—1688
Michigan, University of	1689—1702
Minnesota, University of	1703—1705
Missouri, University of	1706—1708
Northwestern University	1709—1716
Ohio State University	1717—1723
Ohio University	1724—1725
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South Dakota, University of	1729
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Yale University	1790—1805

INDEXES OF CHANGE IN ATTITUDES AND BEHAVIOR AMONG STUDENTS ENROLLED IN GENERAL SPEECH COURSES

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PART I

Gains in Speech Attitude and Social Behavior and Relationship of the Same to Amounts of Speech Instruction

DURING the past few years a number of studies have been reported which involved the administration of some personality test at the beginning and at the end of a period of general speech training. Glenn Moore¹ found significant changes in Bernreuter Personality Inventory scores among students enrolled in speech and no significant change among the members of the control group. Franklin Knower² has reported significant changes in Speech Attitude Scale scores resulting from two administrations of the scale during periods of speech training. Forrest Rose³ found significant changes in two of the Bernreuter Personality Inventory scores accompanied by smaller, though definite, changes in the control group. These studies have lent some factual support to the theory that speech training has a positive effect upon the personality of the student.

Rose⁴ stated, however, that conclusions regarding the educational significance of changing personality test scores "are of necessity qualified by the efficiency of the measuring instrument." In view of the difficulties which have been encountered in the use of personality tests, his warning is a timely one. Many such tests and inventories consist primarily in a series of self-estimates and self-descriptions by the subject, and the scores can therefore reflect the influence of spurious psychological factors such as over-evaluation, under-evaluation, wishful thinking, and deliberate manipulation. It is conceivable that students enrolled in speech courses show greater gains in personality test scores than do other students because the former receive

¹ Moore, Glenn. "Personality Changes Resulting from Training in Fundamentals of Speech," *Speech Monographs*, 2, (1935), 56-59.

² Knower, Franklin. "A Study of Speech Attitudes and Adjustments." *Speech Monographs*, 5, (1938), 130-203.

³ Rose, Forrest. "Training in Speech and Changes in Personality," *Quarterly Journal of Speech*, (April, 1940), 193-196.

⁴ *Ibid.*, 194.

instruction regarding the relationships between speech and personality and because they unconsciously or consciously wish to exhibit a better personality score at the end of the training than they did at the beginning. There is nothing in the experimental situation to prevent a spurious rise in test scores, and there are motivational factors

TABLE I
TEST SCORE GAINS

GROUP	N	AV. 1	AV. 2	DIFF.	CR	R	TR	GR
<i>Speech Attitude Scale 1938-39</i>								
Speech 1 men	57	288	313	25	5.91	.78	6	5
Speech 5 men	49	310	358	48	7.09	.60	10	10
Speech 1 women	65	271	303	32	7.75	.63	6	11
Speech 5 women	24	299	327	28	6.11	.84	10	10
<i>Speech Attitude Scale 1939-40</i>								
Speech 1 men	71	311	327	16	3.92	.72	6	6
Speech 5 men	43	321	348	27	7.58	.76	10	10
Speech 1 women	95	288	305	17	5.12	.77	6	8
Speech 5 women	47	305	327	22	4.05	.72	10	10
<i>Minnesota Inventory of Social Behavior 1939-40</i>								
Speech 1 men	78	141	146	5	3.68	.74	6	6
Speech 5 men	43	143	152	9	4.02	.65	10	10
Speech 1 women	97	138	141	3	2.21	.74	6	5
Speech 5 women	47	144	150	6	2.94	.76	10	10
<i>Speech Attitude Scale 1939-40 (selected)*</i>								
Speech 1	49	314	326	12			6	5
Speech 5	49	317	341	24			10	10
<i>Minnesota Inventory of Social Behavior 1939-40 (selected)*</i>								
Speech 1	49	144	148	4			6	4
Speech 5	49	145	154	9			10	10

* College of registration held constant.

present which are conducive to such an outcome, particularly if the students suspect that their grades will be affected by their responses to the second administration of the test.

One method of bringing such factors under control would be to compare two groups of speech students receiving different amounts of formal speech training within a given period of time, and determining in that way whether or not the rise in test scores is propor-

tional to the amount of time spent in the classroom. It was possible to make such a study at the University of Minnesota because the basic course in the Department of Speech is offered in two sequences: Speech 1, 2, 3, a three quarter course in which the student attends class three hours per week, and Speech 5, 6, a two quarter course in which the student attends class five hours per week. Considered in their entirety the two sequences differ only in the rate at which the work proceeds. The students in the Speech 1, 2, 3 sequence have acquired six hour credits at the end of the second quarter, whereas the students in the Speech 5, 6 sequence have acquired ten hour credits during the same period. All course projects involving formal instruction about personality are concluded by the close of the first quarter.

The Speech Attitude Scale⁵ was given to randomly selected sections in the basic course at the beginning of the fall quarter and the end of the winter quarter during the years 1938-39 and 1939-40. The Minnesota Inventory of Social Behavior⁶ was given, with the same time interval between administrations, during the year 1939-40. The results are reported in Table I.

Table I presents the following data, in order from left to right: the number of cases in each group, the average resulting from the first administration of the test, the average resulting from the second administration of the test, the difference between the two averages, the critical ratio of the difference expressed in terms of sigmas, the correlation of scores resulting from the two administrations of the tests, the ratio of amounts of formal instruction received by Speech 1, 2, and Speech 5, 6 expressed in terms of earned credit hours, and the ratio of average gains in test scores expressed in tenths.

An inspection of the results shows that the average score resulting from the administration of the test at the end of the course is always higher than the average resulting from the administration of the test at the beginning of the course. The differences are in most instances statistically significant, the correlations between the first and second scores being taken into account in computing the critical ratios. A rough proportionality is demonstrated as between the training ratios and the test score gains ratios.

An examination of the "Av. 1" column shows, however, a consistent difference in initial scores favoring the Speech 5 students

⁵Knower, Franklin. *Speech Attitude Scale, Form F*, C. H. Stoelting Co., Chicago.

⁶Williamson, E. G. and Darley, J. G. *The Minnesota Inventory of Social Behavior, Form B*. The Psychological Corporation, New York.

over the Speech 1 students, and indicates the presence of selective factors. Previous studies of the two groups had shown the writer that the selective elements were probably associated with college of registration, and it was deemed advisable to make a comparison involving as many Speech 5 students among the 1939-40 subjects as could be matched for college of registration and sex with Speech 1 students. Forty-nine such cases were found and the comparisons are given in the last two sections of Table I. It will be observed that the matching greatly reduces the differences in initial scores, and that the test score gains ratios correspond roughly to those resulting from the comparison of groups which were not matched for college of registration.

The rise in scores demonstrated in this study is consistent with the results of previous similar studies, and adds confirmation to the general conclusion that some personality test scores change during a course of speech training in what is presumed to be a favorable direction. This study justifies the inclusion of the Minnesota Inventory of Social Behavior in the list of inventories and scales exhibiting that function. We are concerned now, however, not so much with the fact that the scores change during a period of training as with the interpretation of those changes. It is assumed here that a demonstrated proportionality as between the amount of test score change and the amount of formal instruction received would be evidence in support of the theory that test score changes are functionally related to speech training. The outcome of the study is consistent with that theory, and is furthermore consistent in general with the results of an additional study in which a direct questionnaire was used to which the subjects responded anonymously.

One hundred speech students, not included in any of the previous groups, were asked to fill in the following questionnaire at the conclusion of a course in general speech.

QUESTIONNAIRE ON SPEECH IMPROVEMENT

The purpose of this questionnaire is to give you an opportunity to evaluate the Speech Course in terms of your personal improvement. Do not write your name on the sheet. Answer frankly and thoughtfully. The following list of terms refers to aspects of speech behavior in which you may have expected improvement. Note carefully the explanatory statement following each term and place a check on one of the letters or the question mark in the "S O L M ?" series. If in respect to a particular item your speech behavior was satisfactory at the beginning of the course, place a check on the "S." If improvement was desirable, but none resulted from taking the course, place a check on "O." If a little improvement resulted, place a check on "L." If much improvement resulted, place a check on "M." If you are uncertain, place a check on "?."

CHANGE IN STUDENT ATTITUDES AND BEHAVIOR 27

1. *Voice* Have you improved in vocal effectiveness? Consider such things as: expressive variation in rate, intensity, and pitch, adequate vigor, suitable phrasing, etc. S O L M ?
2. *Bodily Expression* Have you improved in the use of your body, face, and arms as expressive agents? Consider posture, freedom from random activity, adjustment of activity to the mood and purpose of speaking, etc. S O L M ?
3. *Language* Have you increased your skill in concisely and vividly expressing your meaning? Consider choice of words, clearness of sentence structure, pronunciation, etc. S O L M ?
4. *Self-Attitudes* Have you learned to face an audience with a feeling of confidence and self-possession? Consider how you feel while speaking: feelings of fear, distress, difficulty in concentrating, comfort, easy grasp of the meaning of words, etc. S O L M ?
5. *Attitude toward Audience* Have you improved in your ability to talk directly and communicatively to an audience? S O L M ?
6. *Thinking* Have you improved in your ability to organize your ideas into a coherent, logical, interesting speech? S O L M ?

On the back of this sheet write any criticisms of the course which occur to you, and make suggestions for its improvement. Be specific.

TABLE II
RESPONSES OF 100 SPEECH STUDENTS TO QUESTIONNAIRE
ON SPEECH IMPROVEMENT

	S	O	L	M	?	
Voice.....	13	3	59	18	7	100
Bodily Expression.....	6	19	48	23	4	100
Language.....	9	12	43	32	4	100
Self-Attitudes.....	14	7	29	50	0	100
Attitude toward Audience.....	14	2	26	55	3	100
Thinking.....	10	6	34	47	3	100

In view of the frequencies of the "L" and "M" responses in Table II it appears, according to student opinion, that greater improvement occurs in speech attitudes than in the other phases of speech, skill. 79% of the subjects indicate improvement in "self-attitudes" and 81% in "attitude toward audience." 77% of the subjects in the 1939-40 study showed a higher Speech Attitude Scale Score in the second administration of the scale than they did in the initial administration, and 63% of the same subjects showed a higher Social Behavior Inventory score. It seems then that evidence of gains in confidence appears in studies using the direct anonymous questionnaire method as it does in those using two administrations of the Speech Attitude Scale, with much the same results, in this instance at least, so far as the percentage of subjects showing gains is concerned.

It cannot be assumed, of course, that all gains of confidence reflected in either type of study are due solely to classroom speech instruction and experience. College students carry on a more or less active social life outside the classroom and it is entirely reasonable to suppose that these activities result in gains in confidence and social effectiveness. John Darley⁷ found significant increases in the Minnesota Inventory of Social Behavior scores among college students, and Forrest Rose⁸ reported gains in Bernreuter Personality Inventory scores among the students in his control group.

PART II

Relationship of Test Score Gains to Other Gains Indexes

The evidence contained in Part I of this report indicates a rough proportionality between average test score gains and the amount of speech instruction received by the subjects, and in that way lends validity to test score changes in so far as they are used for group comparison. A more severe test of validity would be the intercorrelation of test score gains with some index of improvement in speech behavior. Such a test would rest upon the assumption that true changes of attitude or personality should be found to correlate to some degree with observable changes in behavior.

It is extremely difficult, however, to secure a dependable index of improvement in speech behavior. A considerable number of detailed facts are included here because they bear upon the general problem of developing such indexes, and because the outcome of this part of the study can be judged only against the background of those facts.

The subjects in the 1939-40 study of changing test scores were rated at the beginning of the fall quarter and near the middle of the winter quarter for general effectiveness in speech by two instructors. The ratings were averaged, and the difference between the two averages for each subject was computed. This is a possible index of improvement, although it is obviously limited by variations in judges' standards and also by the operation of internal criteria. That is, the judges on both occasions may have been rating in accordance with the relative skill of the subjects in comparison with each other, rather than in comparison with some set of criteria which remains constant from the first to the second performance.

⁷ Darley, John, "Changes in Measured Attitudes and Adjustments," *Journal Soc. Psychol.*, 9, (1938), 189-199.

⁸ Rose, Forrest, *op. cit.*, 194-195.

From a theoretical point of view, a great advantage in objectivity could be gained if the amount of improvement were judged by a direct comparison of two samplings of the subject's speech, one representing his skill at the beginning of the course and the other representing his skill after a period of speech training. Moving and talking pictures taken at the beginning and end of a period of training would serve such a purpose admirably. Unfortunately the cost is prohibitive except for the most richly endowed research projects. Voice recordings have possibilities, since they permit a permanent record of the students' speech efforts early in the course, and a comparison of the same with later efforts. The voice record, however, provides a permanent impression of only the audible symbols and excludes the visible symbols of speech. It is of importance, in evaluating matched voice recordings as an index of speech improvement, to know the relative weights of the audible and visible symbols. An attempt was made to determine the same through the following study.

Fifty speech students from the General College of the University of Minnesota were used in the experiment. There were twenty-six students in Group I and twenty-four in Group II. While these subjects were making voice recordings of two and one-half minutes in length, they were rated for general speech effectiveness by three sets of judges. One set of judges was located in a sound proof room facing the speakers, and about thirty feet away, from which they could see the speakers but could not hear them. Their judgments of the effectiveness of the speakers were based solely upon seeing them enter the room, speak into the microphone, and walk out of the room. Another set of judges was behind a screen where they could hear the speakers but could not see them. A third set of judges was seated in front of the speaker in a normal speaker-audience relation where they could both see and hear him. The subjects entered the room singly, read a short prose selection, talked extemporaneously, and left the room. The ratings for each set of judges were averaged to provide three indexes of speech effectiveness: (V) based upon visible symbols, (A) based upon audible symbols, (G) based upon audible and visible symbols.

At the conclusion of the experiment the recorded speeches were copied in shorthand and transferred to typed manuscripts. These written speeches were then rated for general effectiveness by a fourth set of judges, and the ratings averaged to provide a fourth index of speech effectiveness: (M) based upon written manuscripts containing the words spoken in the original performances.

The reliabilities of the four types of judgment were determined

by correlating the averaged ratings of one-half of the judges in each set with the ratings of the other half of the judges. These coefficients were then corrected for twice the number of judges. The results are given in Table III.

The experimental segregation of the various types of speech sym-

TABLE III
RELIABILITY COEFFICIENTS FOR SEGREGATED SPEECH SYMBOLS

TYPE OF JUDGMENT	JUDGES		RELIABILITY	
	N-I	N-II	I	II
V (speaker seen).....	4	4	.84	.82
A (speaker heard).....	5	4	.92	.92
G (speaker seen and heard).....	7	4	.98	.84
M (manuscript read).....	8	8	.84	.82

bols permits an estimate of the relative importance of each classification. The highest correlations are those between ratings based exclusively on audible symbols with those based on both audible and visible symbols. The negligible correlations for the judgments based upon the reading of the manuscripts indicates that using short samplings in an experimental situation the things said by the subjects have little weight in determining the ranks of the speakers. Judgments based exclusively upon visible symbols correlate definitely with the general criterion scores, but less than do the judgments based upon audible symbols. Computations based upon the relative tendencies of extreme V and A scores to "pull" the G scores toward the extremes of the G distribution yields a weights ratio of 68 to 100. The correla-

TABLE IV
INTERCORRELATIONS OF SEGREGATED SPEECH SYMBOLS

	GROUP I	GROUP II
V vs G.....	.47	.55
A vs G.....	.75	.77
M vs G.....	.28	-.01
V vs A.....	.39	.41

tions between the judgments based upon the voice alone and judgments based upon voice and appearance are high, and show that voice recordings contain a substantial proportion of the factors making for speech effectiveness.

It is interesting to note that the V and A scores correlate significantly despite the fact that the judgments on which they are based depend upon two different sensory avenues, i.e., the eye and the ear.

There are evidently some common factors affecting the function of the voice as well as general or specific bodily movements. Possibly the purposefulness with which the speakers entered the room, the bodily balance while standing before the microphone, the incipient gestures, the activity of facial muscles while talking influenced the ratings of those judges who could see but could not hear the speakers, and were at the same time indicative of physiological conditions in the speaker which were conducive to effective functioning of the voice.

Each student in the 1939-40 study made a one and one-half minute voice recording at the beginning and the end of the fall quarter, and at the beginning and the end of the winter quarter. The material recorded was original extemporaneous speech in which the student expressed a positive attitude on some subject of his own choosing. This provided four samplings of each subject's speech taken at different periods from the beginning to the end of two quarters of speech training. To secure indexes of improvement the first and second record for each student were played in quick succession and ratings were made to determine the amount of the difference in the general effectiveness of the two samplings. The students themselves, about twenty-five in each section, acted as judges. They received the following instructions before the ratings were made.

"We will now play back the two records which this class has made during the quarter. This will give you a more extended sample of your speech than you previously had. At the same time we will make comparisons of the first and second records of each individual to determine which of them is the more generally effective. Please note carefully the following instructions:

1. On the rating form supply the information requested: name, date, section, etc.
2. In the space below the word "subjects" write the first name announced by your instructor.
3. The instructor will play the two recordings of that individual in the order in which they were made.
4. If you think the second record is superior to the first, place a plus sign in the space after the subject's name, and encircle a number on the scale which follows to indicate how much superior the second record is. If you think the second record is inferior to the first, place a minus sign in the space provided, and encircle a number on the scale to indicate how much inferior the second record is. If you observe no difference in general effectiveness between the two records, place a zero in the space provided.
5. Your criterion of comparison is *general effectiveness*. You are making a comparison of the two recordings which represents your over-all judgment as to which impresses you most favorably in its total effect upon you. Regard the records as samples of the individual's speech, rather than as completed one and one-half minute speeches.

6. Your ratings should represent your own judgment. Pay no attention to your neighbor.
7. Your ratings should represent your most competent judgment. The comparisons will not affect individual quarter grades.
8. No comments will be made until the whole series of comparisons has been completed.

RATING SCALE

Date:

Section: No. Hour Days Instr.

Judged by Sex Age

The judgments expressed in the following ratings have reference to the relative superiority or inferiority of the second voice recordings as compared with the first voice recordings.

<i>Subjects</i>	<i>Ratings</i>
.....	1 2 3 4 5 6 7 8 9
.....	1 2 3 4 5 6 7 8 9

The ratings were averaged to provide an index of improvement for each subject. At the end of the winter quarter the third and fourth records were compared and an index of improvement was computed by averaging those ratings. The two averages for each subject were then combined to provide an index of improvement for the fall and winter quarters.

The reliability of the student ratings was determined by correlating one-half the judges against the other half, a coefficient of .81 resulting. In view of the fact that the ratings of all student judges were used in computing the final indexes the reliability is undoubtedly high. The fall quarter records of one speech section were compared by fourteen graduate and advanced students of speech, and a correlation of .78 was found between these ratings and the ratings given the same subjects by their own classmates. In order to secure evidence as to the adequacy of one and one-half minute speeches, the members of two speech sections made two voice recordings within an interval of four days. These two sets of records were rated for general effectiveness and were found to correlate .73.

The two indexes of improvement in speech behavior, one based upon ratings for general effectiveness and one based on comparisons of voice recordings, were then correlated with individual changes in Speech Attitude and Social Behavior test scores. The coefficients resulting were too low to be regarded as having statistical significance. This indicates an absence of relationship between changes in test scores and changes in behavior, so far as the data of this study are concerned, and may throw some doubt upon the significance of per-

sonality test score changes occurring in speech courses. The writer wishes to warn, however, against the premature acceptance of that point of view. It is quite possible that very important and beneficial attitudinal changes may occur in students which do not have an immediate and obvious effect upon their speech behavior. Furthermore, the technical problems of measuring improvement in speech behavior are difficult ones, and need further study. In the opinion of the writer the experiments described in Part II of this report are of value chiefly in throwing some light on the possibility of securing indexes of speech improvement by comparing voice recordings made at the beginning and end of a period of speech training. They show a substantial correlation between judgments of general effectiveness based upon voice recordings and judgments of general effectiveness made in the actual presence of the speaker. They show also a very high order of agreement among student judgments as to the differences in general speech effectiveness represented in voice recordings made at the beginning and at the end of a period of training. Two sets of records made by the same group of subjects within an interval of a few days were found to correlate substantially with each other. These facts all lend support to the theory that matched recordings will eventually prove to be extremely valuable as measures of educational gains in speech, but more direct attacks upon the technical problems of matching records need to be made to show the reliability of two or more sets of such indexes made simultaneously, to demonstrate the relative value of different types of speech material in representing the ability of the subjects, and to determine length of sampling needed.

AN EXPERIMENTAL STUDY OF THE EFFECTS OF GROUP DISCUSSION UPON THE SOCIAL ATTITUDES OF COLLEGE STUDENTS*

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I. INTRODUCTION

IT WAS the purpose of this study to determine experimentally some of the effects of group discussion upon the attitudes of college students towards social problems.

By *group discussion* is here meant, "The reflective deliberation of problems by persons thinking and conversing together cooperatively in face-to-face or co-acting groups under the direction of a leader."¹ The concept, *reflective thinking*, is used as Dewey and others employ the term.² A typical act of thought is: "(1) A felt difficulty or problem; (2) its location and definition; (3) suggestion of possible solutions; (4) development by reasoning of the bearings of the suggestions; (5) further observation and experiment leading to its acceptance or rejection, that is, the conclusion of belief or disbelief."³ Dashiell, reporting a number of experimental studies in discussion and closely related fields, notes that "qualitatively, group discussion seems to be adequately characterized by the traditional analyses of individual thinking as, *e.g.*, stated by Dewey."⁴ Most textbook writers on discussion have, in fact, adopted some variation of this five step analysis as the typical pattern of group discussion.⁵

* This study is a part of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Northwestern University.

¹ McBurney, James H. and Hance, Kenneth, *The Principles and Methods of Discussion*, Harper and Brothers, New York, (1939), 10.

² Dewey, John, *How We Think*, D. C. Heath and Company, Boston, (1910), Chapter VI. See also Burr, Edwin A., *Principles and Problems of Right Thinking*, Harper and Brothers, New York, (1928), Chapter IV.

³ *Ibid.*, 72.

⁴ Dashiell, J. F., "Experimental Studies of the Influence of Social Situations on the Behavior of Individual Human Adults," *Handbook of Social Psychology*, (ed. Carl Murchison), Clark University Press, Worcester, Mass., (1935), 1131.

⁵ McBurney and Hance, *op. cit.*, 11-13. See also Judson, Lyman S. and Judson, Ellen, *Modern Group Discussion*, H. W. Wilson Co., New York, (1937), 17-19; Elliott, Harrison S., *The Process of Group Thinking*, Association Press, New York, (1932), 35-41.

This definition also conceives of discussion as a *cooperative activity*. Discussion is a group undertaking in which all members of the group work together in an effort to better understand the problem under consideration, and, if possible, to reach some consensus of opinion on this problem. Participants are urged to "consider the common good," "assume their share of group responsibility," "contribute objectively," "listen to understand."⁶ Whereas a debate is a competition between opposing or logically incompatible outcomes of thought on a given problem, discussion is a cooperative effort to solve such a problem. Its purpose is inquiry rather than advocacy.

The typical situation for discussion is the face-to-face group with the participants seated in a circle or at least arranged so that every person can readily see and hear every other person without moving to the front of the room. Various techniques, such as the panel and the symposium, have been devised to implement discussion in larger, co-acting groups, but we shall not be concerned with these methods in this study.

Another typical aspect of discussion is *leadership*. One member of the group serves as a coordinator and moderator. His function is to help the group realize its full potentialities in a cooperative, problem-solving inquiry. The concept is that of the democratic leader as described by Tead and others.⁷

The purpose of this study, as stated, is to determine the effects of discussion upon the *attitudes* of college students towards social problems. The term, *attitude*, following Thurstone and others, will be here used to denote the sum total of man's inclinations and feelings, prejudices or bias, preconceived notions, ideas, fears, threats, and convictions about any specific topic.⁸ *Opinion* is the usual way in which we express our attitudes and will mean here "a verbal expression of attitude."⁹

The study had its origin in the very practical question: What are the outcomes of discussion? What significance does discussion have in learning groups as an educative method? What are its values as a policy-determining technique in committees, boards, and other such groups? In the last twenty years there has developed a marked interest in discussion as a social and educational tool. This interest manifests

⁶ McBurney and Hance, *op. cit.*, 93-97.

⁷ Tead, Ordway, *The Art of Leadership*, Whittlesey House, McGraw-Hill Book Company, New York, (1935); McBurney and Hance, *op. cit.*, Chapter VIII.

⁸ Thurstone, L. L., and Chave, E. J., *The Measurement of Attitude*, The University of Chicago Press, Chicago, (1929), 6-7.

⁹ *Ibid.*, 7.

itself in a growing body of literature. Much of this literature is didactic in character, in the form of textbooks, pamphlets on method, and some philosophical approaches.

A number of experimental studies on the effects of group discussion have also been reported and serve as an orientation for this present problem. Among these are the work of Bekhterev, Jenness, and Gordon on judgments of time weight, and size; that of Watson on word building; that of Dashiell on the accuracy of reporting; that of Carr on committee work; that of Shaw on problem solving; that of Jones, Spence, and Bain on discussion versus the lecture method of teaching; that of Burt and Munsterberg on sex differences in discussion. Attitude studies were conducted by the *Inquiry* (reported by Lindeman), Anderson, Simpson, and others.

In this study the following hypotheses were set up as questions to be answered by experimentation:

1. Do changes take place in the attitudes of individuals towards social problems as a result of their participation in group discussion?
2. If such changes do occur, are they significant in amount?
3. If such changes do occur, what is the nature and distribution of these changes?
4. If shifts in attitude result, under what sort of conditions do they occur?
5. What relationship, if any, exists between changes in attitudes and the following factors:
 - a. Initial attitudes
 - b. The information a person possesses on a given problem
 - c. Sex
 - d. Temperament
 - e. The number of participations
 - f. Mental alertness test scores
 - g. The nature of the problem discussed
6. What incidental outcomes of discussion may be observed?
 - a. Is group discussion useful in analyzing the background of problems?
 - b. Does it help to provide solutions for problems?
 - c. Does group discussion teach persons to work cooperatively?

II. THE EXPERIMENTAL PROCEDURE

Four experiments were conducted in an effort to answer these questions. Subjects were 336 sophomores in the course in Argumentation in the School of Speech of Northwestern University. They were divided into 43 discussion groups, ranging in size from 8 to 20 persons, the average size being 13 students. Of these there were twelve

groups specially constituted. These included two composed entirely of women, four wholly of men, two of students with mental alertness scores of B or better, and four of persons who were unprepared on the question they discussed. The other 31 groups were heterogeneous as to sex, and were equated as to age, year in school, intelligence, and previous speech training. Control subjects were 225 sophomores in the School of Speech and the College of Liberal Arts, similarly equated.

In the first and second experiments two problems were considered by each discussion group. These were worded as follows: (1) What Policies Should the United States Use in Keeping out of War? (2) Should the Several States Abolish Capital Punishment? In experiments three and four only the second problem was discussed.

In the first experiment the subjects began by studying the theory of group discussion from a specially prepared syllabus for a period of one month. Mastery of the content was encouraged by giving two examinations covering the materials studied. During this time, the students learned to use discussion techniques by engaging in practice discussions once a week for the four-week period. Training in both participation and leadership was thus provided. These discussions were evaluated by faculty and graduate student observers, who recorded on a check list for discussion, the number and kind of participations, the type of leadership, the conclusions and solutions reached by the groups, as well as the logical pattern of the discussions. Ten days in advance of the experimental discussions, bibliographies of readings on problems for the experimental discussions were distributed. After the students had investigated these questions, they were required to submit discussion outlines as inventories of their reading and thinking. Each group then held a two-hour discussion on each of the two problems. These discussions were under student leadership, and were again checked by faculty and graduate student observers who had previously been trained in this procedure.

Attitude changes were measured by the use of the Thurstone Attitude Scales which were administered immediately before and after discussion. Tests used were Scale number 2 on War and Scale number 31 on Capital Punishment. Twenty groups, heterogeneous as to sex took part in the discussions. Control subjects did not discuss, but were given successively the two forms of the Thurstone scales on each problem.

In the second experiment the same procedure was used with certain additions. One of these was the administering of a subject matter or information test immediately before and after discussion in order to measure the amount and kind of information obtained by subjects.

In this experiment, temperament profiles were secured by the use of the Humm-Wadsworth Temperament Scale. Also, mental alertness test scores were obtained for all subjects from the personnel office of the University. These scores, as well as the recorded findings on number and kind of participations, were compared with shifts in attitude as measured by the Thurstone scales. Six groups heterogeneous as to sex were used in this experiment; eight homogeneous groups, two of high intelligence, two of women, and four of men, also took part.

The third experiment was conducted without a period for the study of theory of discussion. Its principal purpose was to check upon the effect of the assigned reading materials upon initial attitudes towards Capital Punishment and to compare shifts resulting from reading with those made because of discussion. To accomplish this, Thurstone Scale number 31 was administered before reading, as well as before and after discussion. This had not been the case in the first two experiments, in which no check had been made upon the effect of the materials read by experimental subjects. An attitude analysis blank was also employed in an effort to explain causes of changes in attitude resulting from reading and discussion. Five groups heterogeneous as to sex participated in this experiment.

In the fourth experiment a further attempt was made to explore the relationship between information and attitude changes. With one exception the procedure was identical with that in the second experiment. Four groups, wholly unprepared, discussed the Capital Punishment problem. In each of these groups, without the knowledge of the other members, a well-informed person was placed. Checks were made upon attitude shifts and individual items as in the first three experiments.

III. RESULTS AND STATISTICAL ANALYSIS OF DATA

All tests and scales were first scored. Tabulations were made of attitude scores and shifts according to each experiment, each discussion group, and by individuals. Temperament profiles, information test scores, mental alertness test ratings, number and kind of participations were similarly recorded and grouped. The data in the four experiments were subjected to three kinds of analysis. Attitude scores on first and second forms of tests were handled first. Means, standard deviation, differences, and critical ratios were computed by the usual statistical methods for the total experimental and control groups in each experiment.

The reliability of the Thurstone Attitude Scales used in the experiments was found by computing the correlations between the scores

of the two forms of each test secured from the control group. A correlation of .943 was secured for the Capital Punishment scale. Mean for Form A was 5.02 with a standard deviation of 2.10; for Form B the mean was 5.02 with a standard deviation of 2.04. Although these tests reputedly have a reliability of .90 when used together, in these experiments the Attitude Scale on War had a reliability of .632. The mean was 7.59 with a standard deviation of .82 on the A Form, while these values were 7.59 and .91, respectively, for Form B.

Because plus and minus shifts of attitude tended to mask each other when means were calculated, a second type of procedure was employed. The individual shifts of attitude were analyzed, using the standard error of estimate as the index of a shift amounting to statistical significance.

Although the standard error of measurement is used in certain kinds of studies for such analysis, it is a device for predicting the probable true score from a fallible score. In using two forms of an attitude scale, however, we are interested not in true scores, but in predicting one fallible score from another. A much more accurate device, therefore, would seem to be the standard error of estimate. This measure, like other standard errors indicates the area within which two-thirds of all scores on a second scale may be expected to fall in a normal distribution. Should more than 32 per cent of the scores go beyond this point of one standard error of estimate in a plus or minus direction, they would be considered statistically significant. Similarly, 95 per cent of the scores should fall within the limits of two standard errors of estimate. Therefore, if over 5 per cent of the scores should fall beyond this point, they would also be statistically significant. In a like manner, 99.99 per cent of the scores should lie within the limits of three standard errors of estimate. Consequently, if over 1 per cent of the scores were beyond this point, they would be considered significant. The method of testing the statistical significance of individual shifts in this second method of analysis of data was in relation to whether or not they exceeded the percentages stated above for each size of shift. The standard error of estimate (σ_{YX}) was derived from the data of the control group by the formula:

$$\sigma_{YX} = \sigma_Y \sqrt{1 - r_{XY}^2}$$

This formula was applied to the data of the study and the resulting figures obtained for each of the two questions discussed:

Standard error of estimate (Capital Punishment):

$$\sigma_{YX} = 2.04 \sqrt{1 - .8892} = .68$$

Standard error of estimate (War):

$$\sigma_{YX} = .91 \sqrt{1 - .3994} = .71$$

This method proved to be a much more satisfactory method because it revealed directional shifts.

A third method of analysis was to apply the individual analysis of shifts to each discussion group in order to discover what effects were obtained within each of these units.

The tables bearing the results of computations follow, being arranged by experiments.

A. EXPERIMENTS ONE AND TWO

1. Nature, Amount, and Distribution of Changes of Attitude

TABLE I
ANALYSIS OF ATTITUDE SCORES SHOWING MEANS, STANDARD DEVIATIONS, DIFFERENCES, AND CRITICAL RATIOS

GROUP	N	Mx	My	DIFF. Y-X	σ_X	σ_Y	R XY	σ DIFF.	CR
C. Cap. Pun...	125	5.02	5.02	0	2.10	2.04	.943	.06	0
Ex. Cap. Pun...	212	4.51	4.34	-.17	2.11	2.08	.720	.107	1.59
C. War.....	100	7.59	7.59	0	.82	.91	.632	.08	0
Ex. War.....	196	7.26	7.68	.42	1.30	1.35	.590	.087	4.82

These data show that there was a significant statistical difference as a result of group discussion on the question of War, on which the critical ratio was 4.82. On Capital Punishment, however, the difference approached significance, the critical ratio being 1.59. This is not large enough to be convincing. The correlations of .720 on Capital Punishment and .590 on War indicate that changes did take place which were not apparent in the differences of the means.

The analysis of individual shifts, however, shows that changes amounting to statistical significance took place on both problems:

TABLE II
ANALYSIS OF INDIVIDUAL SHIFTS SHOWING THOSE GREATER THAN ONE, TWO, AND THREE STANDARD ERRORS OF ESTIMATE

GROUPS AND PROBLEM	N	OVER 1 σ YX				OVER 2 σ YX				OVER 3 σ YX			
		Tot.	+	-	%	Tot.	+	-	%	Tot.	+	-	%
Cap. Pun. (C)...	125	15	11	4	12.0	1	1	0	.8	0	0	0	0
Cap. Pun. (E)...	212	114	49	65	53.2	62	30	32	28.9	40	19	21	18.1
War (Control)...	100	28	10	18	28.0	0	0	0	0	0	0	0	0
War (Exp.).....	196	123	87	36	62.3	68	46	22	33.6	21	12	9	9.9
Totals (Cont.)...	225	33	21	22	14.6	1	1	0	.4	0	0	0	0
Totals (Exp.)...	411	237	136	101	57.8	130	76	54	31.3	61	31	30	14.0

In estimating the significance of individual shifts it will be recalled that groups made statistically significant changes when the total number of shifts over one standard error of estimate was 32 per cent or greater, when the percentage of shifts over two standard errors was five or greater, or when there was more than one per cent of the subjects who made changes over three standard errors of estimate. The data above show that group discussion, therefore, produced changes in attitudes on the problem of Capital Punishment and the problem of War which were statistically significant.

An examination and totalling of the individual shifts by discussion groups showed that all 43 groups in the two experiments made changes of attitude which were statistically significant.

2. Number and Kind of Participations in Relation to Attitude Changes

TABLE III
RELATIONSHIP OF NUMBER OF PARTICIPATIONS TO ATTITUDE SCORES

SUBJECTS AND PROBLEM	No.	NO. OF PART	AV. NO. PART	R	S.E. OF R
Capital Pun. Men	81	1320	16.3	-.087	± .15
Capital Pun. Women	126	1500	11.8	.133	± .07
War Problem Men	80	1344	16.8	.0083	± .18
War Problem Women	112	1374	12.2	.0846	± .11

The combination of the data on the two experiments leads to these two conclusions: (1) Men had a greater number of participations than women; (2) there is virtually no correlation between number of participations and attitude scores as evidenced by the coefficients of correlation.

TABLE IV
RELATIONSHIP OF SHIFTS OF ATTITUDE OF ARGUMENTATIVE AND DOGMATIC SUBJECTS AS COMPARED WITH THOSE OF COOPERATIVE SUBJECTS

TYPE OF SUBJECT	No.	SHIFTS OVER 1σYX		OVER 2σYX		OVER 3σYX	
		No.	Per cent	No.	Per cent	No.	Per cent
Arg. and Dog.	51	31	61.9	19	36.1	11	21.3
Coop. and Fr.	359	206	56.9	48	29.3	50	10.5

These data reveal that in each case, persons who were inclined to be dogmatic and argumentative in discussion had a higher percentage of significant shifts than did those who were cooperative and friendly.

3. *Attitude Scores in Relation to Initial Attitudes of Subjects*

In the interpretation and analysis of attitude scores with respect to initial attitude, the designations given in the instruction sheets for each of the two scales were used as a basis for classifying scores. They appear below :

TABLE V
TEST SCORES WITH ATTITUDES WHICH THEY REPRESENT (THURSTONE)

CAPITAL PUNISHMENT		WAR	
Score	Attitude	Score	Attitude
0-3.4	Strongly opposed (SO)	0-2.9	Extremely militaristic (EM)
3.5-4.9	Slightly opposed (SLO)	3.0-3.9	Strongly militaristic (SM)
5.0-5.9	Neutral (N)	4.0-4.9	Mildly militaristic (MM)
6.0-7.4	Mildly favorable (MF)	5.0-5.9	Neutral (N)
7.5-11.0	Strongly favorable (SF)	6.0-6.9	Mildly pacifistic (MP)
		7.0-7.9	Strongly pacifistic (SP)
		8.0-11.0	Extremely pacifistic (EP)

The initial and final scores in the two experiments on both problems were distributed according to the interpretations above. The tables below show the number of persons in each of the five attitude groups on Capital Punishment before discussion, and also reveal how the same individuals originally in these divisions were distributed after discussion (Table VI). The same method was used in analysis of the attitude scores on War (Table VII).

An analysis of the data in Table VI leads to several conclusions. First, experimental subjects showed a greater percentage of change in each initial attitude division than did persons in control groups. Secondly, the experimental subjects shifted into a greater number of final attitudes as a result of their discussions than did the control subjects who held no discussions. In no initial attitude division did experimental subjects shift to less than three different final positions. In two sections they went to four. However, in no initial attitude section did persons in the control group shift into more than two final positions, and in one case no change occurred at all. Thirdly, persons in the experimental division had a greater range of shifts than control subjects. In a number of cases, persons changed from one end of the scale to the other, a shift of five divisions on the scale. This was

true of the SF subjects who moved to SO. Some MF subjects changed to SO, a shift of four divisions. Many moved as far as three divisions. In the control group, however, this did not occur. In four of the five initial attitude divisions, no person moved beyond the next attitude division above or below his original position. Only one person in 125

TABLE VI
DISTRIBUTION OF INITIAL ATTITUDES OF CONTROL AND EXPERIMENTAL GROUPS
BEFORE AND AFTER DISCUSSION

CAPITAL PUNISHMENT					
EXPERIMENTAL 211 SUBJECTS			CONTROL 125 SUBJECTS		
Before Disc.	After Disc.		First Form	Second Form	
111-SO →	88-SO 7 SLO 13-N 3-MF	79% same 21% changed	41-SO →	38-SO 2-SLO 1-N	92% same 8% changed
8-SLO →	1-SLO 3-SO 2-N 1-MF 1-SF	12% same 88% changed	8-SLO →	3-SLO 3-N 2-SO	38% same 62% changed
40-N →	19-N 3-SLO 9-SO 7-MF 2-SF	49% same 51% changed	30-N →	25-N 1-SLO 4-MF	84% same 16% changed
29-MF →	13-MF 7-N 6-SO 3-SF	45% same 55% changed	29-MF →	27-MF 2-N	93% same 7% changed
24-SF →	9-SF 8-MF 4-N 3-SO	37% same 63% changed	17-SF →	17-SF	100% same

SO—strongly opposed SLO—slightly opposed
N—neutral MF—midly favorable
SF—strongly favorable

control subjects made a jump of two scale divisions. This was from SO to N. Next, a distinct skewing of the experimental group at the SO position was observed. Seventy of the 125 persons held initial positions at that point. Some of this tendency occurred in the control group, though not to such an extent. Another fact observed was that SO experimental subjects had the smallest percentage of change. The only factor known to operate definitely as a part of the experimental situation was that of the assigned reading material on Capital Punish-

ment. This may have been responsible for what occurred in the SO group.

The analysis of the initial and final attitude positions on War substantiates the first three findings listed above. The experimental section shifted into a greater number and variety of final attitudes, a greater percentage of each initial attitude group showed shifts of

TABLE VII
DISTRIBUTION OF INITIAL ATTITUDES OF CONTROL AND EXPERIMENTAL GROUPS
SHOWING COMPARISON BEFORE AND AFTER DISCUSSION

WAR					
EXPERIMENTAL (196 SUBJECTS)			CONTROL (100 SUBJECTS)		
Before Disc	After Disc.		First Form	Second Form	
53-EP →	38-EP 14-SP 1-N 3-MP	71% same 29% changed	31-EP →	26-EP 4-SP	83% same 16% changed
80-SP →	33-SP 38-EP 5-MP 5-N 1-MM	41% same 59% changed	51-SP →	37-SP 6-EP 8-MP	74% same 26% changed
41-MP →	3-MP 21-SP 12-EP 3-N 2-MM	.7% same 99.3% changed	14-MP	6-MP 7-SP 1-N	44% same 56% changed
12-N →	1-N 1-SP 3-EP 5-MP 2-MM	8% same 81% changed	4-N →	3-N 1-MM	75% same 25% changed
5-MM →	1-EP 2-SP 1-N 1-MM	100% changed	0-MM		

EP—Extremely pacifistic

SP—Strongly pacifistic

MP—Mildly pacifistic

N—Neutral

MM—Mildly militaristic

opinion, and the range of shifts was greater. Both experimental and control groups were definitely skewed at the SP position. Moreover, 174 of the experimental subjects, or 90 per cent were opposed to war, an attitude typical of college students at the time of the experiments.

4. Relationship of Sex to Changes of Attitude

Another variable considered was that of the sex of the subject in relationship to changes of attitude. The first observation was made

from the data of the large experimental groups and control groups in which shifts made by men and women are compared. The analysis of individual shifts is made below.

TABLE VIII
INDIVIDUAL SHIFTS OF MEN AND WOMEN SHOWING THOSE GREATER THAN ONE,
TWO, AND THREE STANDARD ERRORS OF ESTIMATE

GROUP AND PROBLEM	N	OVER 1σYX				OVER 2σYX				OVER 3σYX			
		Tot.	+	-	%	Tot.	+	-	%	Tot.	+	-	%
Cap. Pun. (C)...													
Men.....	51	4	4	0	8.0	1	1	0	2.0	0	0	0	0
Cap. Pun. (C)...													
Women.....	74	12	7	5	16.2	0	0	0	0	0	0	0	0
Cap. Pun. (E)...													
Men.....	85	46	23	23	54.2	24	13	11	28.0	14	6	8	16.2
Cap. Pun. (E)...													
Women.....	127	68	25	43	48.5	38	16	22	24.3	26	15	11	16.8
War (Con.)													
Men.....	45	14	12	2	31.0	0	0	0	0	0	0	0	0
War (Con.)													
Women.....	55	14	7	7	25.4	0	0	0	0	0	0	0	0
War (Exp.)													
Men.....	80	55	34	21	39.6	34	22	12	46.7	12	8	4	17.1
War (Exp.)													
Women.....	116	70	56	14	67.8	34	27	9	25.6	9	4	5	6.3
Totals (Con.)													
Men.....	96	18	16	2	18.7	1	1	0	.9	0	0	0	0
Totals (Con.)													
Women.....	129	26	12	12	20.6	0	0	0	0	0	0	0	0
Totals (Exp.)													
Men.....	165	101	57	44	46.9	58	35	23	37.3	26	14	12	16.6
Totals (Exp.)													
Women.....	243	138	81	57	58.6	72	42	31	24.9	35	19	16	11.5

On War, women had a greater percentage of small shifts, those over one standard error of estimate, but men had larger percentages of larger shifts, those over two and three standard errors. The totals for the two problems showed that women made a greater percentage of small changes while men made a greater percentage of large shifts.

A further check on the relationship of sex to attitude changes was carried on in the discussion groups which were homogeneous as to sex. There were six of these, two composed entirely of women and four entirely of men. One discussion group, entirely of women, was described by the observers in this interesting fashion: "Group #4 on Capital Punishment was almost a 'cat fight,' although no hair was pulled. Participants could reach no agreement on a solution to the problem and tended to personalize their remarks."

Groups composed entirely of women had the smallest percentages of shifts of opinion; men in men's groups had percentage of changes from two to three times as great as those in women's groups. The men also made a greater number of large changes than did women, who were confined primarily to small shifts of attitude under these conditions.

5. Relationship of Individual Shifts of Attitude to Temperament

In comparing shifts of attitude with temperament, the profiles taken from the Humm-Wadsworth Temperament Scale were used. A general observation was first made to see whether any particular type of profile corresponded frequently with certain size of attitude change. Subjects who demonstrated high plus scores in temperament components, were noted especially. The Normal, the Manic, and the Depressive seemed to be high on many subjects. Arbitrarily, all students who made shifts of two units on the Thurstone scales were placed in one group. In a second group were all subjects shifting from one to two units. Means on the Normal, Manic, and Depressive components were calculated for each group and the results compared. They appear in the table which follows.

TABLE IX
RELATIONSHIP OF MEANS ON TYPICAL PROFILE COMPONENTS ON THE HUMM-WADSWORTH TEMPERAMENT SCALE AND THE INDIVIDUAL SHIFTS OF ATTITUDE (THURSTONE SCALE UNITS)

CAPITAL PUNISHMENT				
SIZE OF SHIFT	N	TEMPERAMENT COMPONENTS		
		Normal	Manic	Depressive
Over 2 units on Thurstone Scale....	11	-.08	+2.30	+2.10
From 1-2 units on Thurstone Scale..	12	+.50	+1.25	+.41
WAR				
Over 2 units on Thurstone Scale....	10	-.10	+2.00	+1.30
From 1-2 units on Thurstone Scale...	26	+.65	+.92	+.15
BOTH PROBLEMS				
Over 2 units.....	21	-.09	+2.13	+1.71
From 1-2 units.....	38	+.60	+1.00	+.26
Means all Subjects.....	86	+.23	+1.58	+.99

These figures indicate a definite relationship between temperament and the size of attitude shifts. Persons making changes of over two units on the Thurstone scale had Normal components which were negative on both problems. Those who shifted from one to two units, however, showed Normal components which were considerably higher, both being plus. The Manic and Depressive components of subjects shifting over two units were much higher than those who changed from one to two scale units. The former were approximately twice as large; the latter from five to six times as great.

These components can be quickly interpreted. Persons lacking the Normal component, those who had negative scores, may be said to lack the "brake" or "balance wheel," which acts as a check upon the other components. The Manic and Depressive comprise the Cycloid, according to Humm and Wadsworth. Individuals having high plus scores on these are characterized by emotionality, fluctuations in activity, and interference with voluntary attention. They are handicapped by such tendencies as emotional thinking, lack of persistence, and changeability of mood. Those making smaller changes had a higher degree of control and less of the Cycloid tendency.

The same relationship between temperament profiles and size of shifts of attitude was observed when an analysis of shifts was made using the standard error of estimate as an index. Those subjects making changes over three standard errors had negative scores on the Normal component and very high Manic and Depressive ratings. Those making changes less than three standard errors (from one to three) had higher Normal ratings and lower Manic and Depressive scores.

6. Relationship of Subject Matter Test Scores to Individual Shifts of Attitude

The next variable to be considered was that of information on the questions discussed in relation to individual shifts of attitude. The tests were first scored by marking them 1, 2, or 3. A rating of 1 was given to those having 100% of the essential information on the test, a grade of 2 to those having 85% of the information, and a grade of 3 to those having 70% or less. At the same time, items gained as the result of discussion were noted as to quantity and quality. They were classified as items pertaining to the analysis and background of the problem under discussion and as items relating to the solution of the question. The next table reveals the comparison between attitude changes and scores on the subject matter test.

TABLE X
RELATIONSHIP OF SUBJECT MATTER TEST SCORES TO INDIVIDUAL
SHIFTS OF ATTITUDE

MEANS AND σ OF ATTITUDE SHIFTS				DIFFERENCES BETWEEN MEANS				
S.M. Test Score	N	Mean of Shifts	σ	1+2	2+3	1+3	σ_D	C.R.
1	85	1.45	2.15	-.21			.17	1.2
2	65	1.66	3.00		-.31		.22	1.4
3	22	1.97	4.00			-.52	.14	3.7

Examination of the data shows a relationship between a knowledge of the question, or the possession of information about it, and individual changes of attitude. The table shows that persons well-informed made the smallest shifts, whereas persons slightly less informed made slightly larger shifts, and those still less informed made even larger shifts.

Of further interest were the incidental findings regarding gains in information as a result of group discussion. The table which follows demonstrates the tabulations on this matter.

TABLE XI
ITEMS OF INFORMATION GAINED DURING GROUP DISCUSSION

PROBLEM	NO. WHO GAINED INF.	NO. SHOWING NO GAIN	NO. OF ITEMS ON BACK- GROUND	NO. OF ITEMS ON SOLUTION	TOTAL	AV. GAIN PER PERSON
Cap. Pun.....	82	4	99	12	111	1.3
War.....	81	5	140	60	200	2.4
Total.....	163	9	239	72	311	1.8

It is quite clear that the discussions furnished a greater number of items on the background of the question than upon the solutions. Significant is the fact that 163 of the 172 subjects taking part in discussion (Experiment Two, only) gained an *average* of 1.8 items, some gaining as high as eight items in individual cases.

7. Analysis of Mental Alertness Test Scores in Relation to Individual Shifts of Attitude

Further analysis was carried on in an attempt to determine whether any relationship existed between changes in attitude and the scores on Mental Alertness test scores made by students on their entrance to Northwestern University. At the outset this difficulty was encountered: Numerical scores on these tests are given in percentiles determined by the particular group with which the person takes the test. These scores are relative, not absolute. Inasmuch as the letter grades are assigned on the tests according to the percentile ranking, it is also a relative rather than an absolute index of intelligence. Consequently, each significant change was classified under the corresponding Mental Alertness score for that subject, using letter grades. If any relationship existed, it would be expected to show up in the distribution in such a way that small changes, for example, would correspond with high test scores. These data are reported below.

TABLE XII
RELATIONSHIP OF MENTAL ALERTNESS TEST SCORES TO INDIVIDUAL SHIFTS OF
ATTITUDE IN TERMS OF STANDARD ERRORS OF ESTIMATE

MA SCORE	SHIFTS FROM 1-2 σ YX	PER CENT OF TOTAL NO. OF SHIFTS	SHIFTS OVER 2 σ YX	PER CENT OF TOTAL NO. OF SHIFTS
A	11	22	8	18.6
B	10	20	11	25.8
C	20	40	18	42.8
D	7	14	5	11.5
E	2	4	1	2.3
Totals.....	50	100	43	100

These figures indicate that no significant difference existed between the percentage of persons with Mental Alertness scores of A who made shifts between 1-2 standard errors of estimate and those whose shifts were greater than this amount. The same is true of the B, C, D, and E groups.

However, a somewhat indirect relationship may be observed between shifts in attitude and intelligence when the Mental Alertness scores are compared with those upon the Subject Matter or Information Test, which have in turn been shown to have a definite pattern in their relationship to changes in attitude. The following table reports these figures.

TABLE XIII
RELATIONSHIP BETWEEN MENTAL ALERTNESS TEST SCORES AND
SUBJECT MATTER TEST SCORES

MA SCORE	SCORE OF 1 ON SUBJECT MATTER TEST		MA SCORE	SCORE OF 2 OR 3 ON SUBJECT MATTER TEST	
	No.	%		No.	%
A	9	40	A	2	5
B	4	18	B	7	19
C	5	24	C	17	48
D	4	18	D	6	17
E	0	0	E	4	11
Totals..	22	100	Tota's...	36	100

The data show that there was a definite relationship between scores of 1 on the information or subject matter test and scores of A on the Mental Alertness test. The distribution shows that 40 per cent of the subjects making a 1 score on tests on two problems were individuals of A rating on the MA test. Furthermore, 82 per cent of the persons scoring 1 on both subject matter tests were C or above in intelligence. This analysis indicates that there was a rather definite relationship between intelligence as measured by the MA test and the

ability to get and report information. Since well informed persons have been shown to make small changes of attitude, there is some logical basis to indicate that individuals of high intelligence tend to make small changes, also.

B. EXPERIMENT THREE

In conducting this experiment it will be recalled that these purposes were most prominent: (1) To check upon the initial attitudes of students previous to any reading; (2) to demonstrate the amount and direction of shifts in attitude caused by readings contained in the bibliography on Capital Punishment used in Experiments I and II; (3) to give some indication of the amount and direction of changes in attitude produced by reading compared with those resulting from discussion; (4) to try to explain to some extent, at least, factors responsible for initial attitudes and in addition, those behind changes in opinion from reading and discussion. The procedure has been explained earlier. The results follow.

1. Shifts in Attitude from Reading versus Shifts Produced by Discussion

An analysis made by the individual shift method is contained in the following table:

TABLE XIV
SHIFTS RESULTING FROM READING AND DISCUSSION IN EXPERIMENTS ONE, TWO, AND THREE

GROUPS OR SUBJECTS	N	OVER 1σYX				OVER 2σYX				OVER 3σYX			
		Tot.	+	-	%	Tot.	+	-	%	Tot.	+	-	%
Reading													
Exp. III.	69	45	9	36	65.2	39	7	32	56.5	28	2	6	40.2
Discussion													
Exp. III.	69	30	11	16	42.8	16	7	6	23.1	8	2	3	11.7
Discussion													
Exp. I.	126	71	28	43	56.3	41	20	21	32.5	28	14	14	22.2
Discussion													
Exp. II.	86	43	21	22	50.0	21	10	11	24.4	12	5	7	14.0

These data demonstrate that reading produced a greater number of significant shifts of attitude than did discussion in Experiment III, in which the discussions were of short duration (approximately thirty minutes), as well as in Experiments I and II in which full two-hour discussions were held. It was also noted that initial attitudes previous to reading were quite widely distributed across the scale from Strongly Opposed to Strongly Favorable, but that reading did "set" the attitudes of the subjects at the Strongly Opposed position, as had

been suspected in the analysis made of Experiments I and II in the previous section.

2. Reasons Given by Subjects for Changes in Attitude Resulting from Reading and from Discussion

The next concern in this experiment was to try to explain the causes for changes in attitudes resulting from reading and from discussion. An analysis and tabulation of the Question Blank on Attitude Changes is reported in the two tables which follow.

TABLE XV
REASONS GIVEN AS THE BASES FOR ATTITUDES BEFORE READING OR DISCUSSION
WITH THE SIZE OF SHIFTS MADE BY SUBJECTS IN EACH CLASS

REASON	NO.	% OF GROUP	NO. SIG. SHIFTS READ.	READ/ AV. SHIFT	NO. SIG. SHIFTS DISC.	DISC. AV. SHIFT
Do not know.....	18	26.0	10	1.50	7	.77
Casual information...	14	22.8	13	2.70	10	1.33
Reading.....	12	17.3	5	1.22	2	.40
Religion.....	10	14.3	6	1.25	5	.65
Parents.....	12	17.3	9	2.49	6	1.01
Part of country.....	3	4.3	2	2.28	0	.16
Totals.....	69	100	45	1.92	30	.70

The largest percentage of changes made among those who could positively account for the basis of their changes of attitude was in the groups stating they were derived from "casual information" (22.8%). This group, which admittedly had less information to start with, also had the largest number of significant shifts in both reading and discussion, as well as the largest shift in both divisions. This seems quite consistent with the earlier findings in both Experiment I and II that additional information was an important factor in changes of opinion in discussion.

TABLE XVI
REASONS GIVEN FOR CHANGES OF ATTITUDES AS A RESULT OF READING

REASON	NO.	% OF GROUP	AVERAGE SHIFT	NO. OF SIG. SHIFTS
Facts—statistics.....	32	46.3	1.1	19
Opinion of author.....	23	33.7	2.0	17
Provoke thought.....	1	1.4	1.4	1
Confirmed my opinion.....	10	14.3	.6	7
Do not know.....	3	4.3	.5	1
Totals.....	69	100	1.8	45

The "gaining of additional facts" was the reason given by most persons, 32 stating this to be the case. The average shift in this case

was 1.1 with 19 significant shifts recorded for this division. Next in importance was the "opinion of the author," with 23 persons giving this as a reason. The average shift in this group was larger, with 2.0 as the average, 17 persons showing significant shifts.

The effect of discussion was also analyzed in a similar way. This information follows in the next table.

TABLE XVII
REASONS GIVEN FOR CHANGES OF ATTITUDE AS A RESULT OF DISCUSSION

REASON	No.	% OF GROUP	AVERAGE SHIFT	No. OF SIG. SHIFTS
Do not know.....	5	7.2	.65	2
Did not change.....	9	13.0	.33	0
Other points of view.....	18	25.9	.94	13
More information.....	15	23.1	1.00	6
Exposed my reasoning.....	2	2.8	1.05	2
Taking part made me surer....	20	29.0	.43	7
Totals.....	69	100	.90	30

This table reveals that subjects taking part in discussion gave "taking part made me surer" as the reason for their changes in attitude in the greatest number of cases. These 20 subjects, comprising 29 per cent of the group, made small average changes, however, the mean shift being .43. There were only seven of this group who made changes which were statistically significant. Apparently one effect of discussion is merely to strengthen opinions already held by those who participate. The most significant reason, however, for change given was "it exposed persons to other points of view." Eighteen subjects, or 25.9 per cent fell within this group, which had the greatest number of statistically significant shifts, and had an average change

TABLE XVIII
SHIFTS OF ATTITUDE AFTER READING AND AFTER DISCUSSION SHOWING THE REGRESSION EFFECT OF DISCUSSION UPON ATTITUDES

SIZE AND KIND OF SHIFT	No. OF SUBJECTS SHIFTING IN (-) DIRECTION ON READING WHO SHIFTED (+) IN DISCUSS.	No. OF SUBJECTS SHIFTING IN (+) DIRECTION ON READING WHO SHIFTED (-) IN DISCUSS.
Not significant on Reading but significant Discussion.....	5	8
Significant on Reading but not on Discussion.....	9	2
Significant on Reading and on Discussion.....	10	8
Totals.....	24	18

of .94. This fact of hearing the opinions of others may help to explain an interesting regression effect of discussion which is shown by the figures in Table XVIII.

These data demonstrate that 42 persons who shifted in one direction (either plus or minus) as a result of reading, moved in the opposite direction as a result of something which occurred during discussion. Since this represents nearly two-thirds of those who took part, it is highly improbable that such movement could have been the result of chance. In other words, discussion seems to cause attitudes to regress towards a middle position if extreme shifts have been made because of reading.

C. EXPERIMENT FOUR

In the first three experiments it was discovered that a relationship existed between the amount of information persons possessed on the questions discussed and the changes in attitudes which they made during discussion. Subjects with little information shifted most; those with much information changed least. Consequently, it was decided to attempt to check this variable in another way. Since discussion groups thus far had gained much of their information from readings assigned previous to discussion, the question was raised: What would occur if groups which did *no* reading and were relatively uninformed on a question were permitted to discuss a problem? This suggested still other questions: Would sufficient information be contributed in the group deliberations to produce changes in attitude which were statistically significant? To what extent would the relationship of little information-large shift of attitude continue? Would it be possible to directly influence such changes resulting from information if well informed persons were "planted" in these groups?

The experimental procedure already described earlier in the paper

TABLE XIX
INDIVIDUAL SHIFTS OF UNINFORMED SUBJECTS SHOWING NUMBER GREATER THAN ONE, TWO, OR THREE STANDARD ERRORS OF ESTIMATE WITH COMPARISON TO INFORMED SUBJECTS IN EXPERIMENTS ONE AND TWO

SUBJECTS	No.	SHIFTS OVER 1 σ yX				SHIFTS OVER 2 σ yX				SHIFTS OVER 3 σ yX			
		Tot. No.	+	-	Tot. %	Tot. No.	+	-	Tot. %	Tot. No.	+	-	Tot. %
Men.....	25	17	13	4	68.0	9	7	2	36	2	1	1	8.0
Women.....	29	16	7	9	55.5	9	5	4	31	5	3	2	17.2
Total.....	54	33	20	13	61.6	18	12	6	54	7	4	3	13
Exp. I & II.....	212	114	49	65	53.2	62	30	32	28.9	40	19	21	18.1

was employed to attempt to answer these question hypotheses. The results are tabulated in Table XIX.

These figures indicate that significant shifts of attitude did occur in groups which were uninformed. Secondly, these changes were not appreciably higher than those in groups which had done some reading on the question except in changes over two standard errors of estimate where the uninformed subjects had a percentage almost twice as great.

The next step in analysis was to compare the shifts of the two groups in which informed persons had been placed with those in which no effort was made to control information. The table below shows the comparative figures of the two types of groups.

TABLE XX
ANALYSIS OF INDIVIDUAL SHIFTS OF OPINION IN GROUPS CONTAINING "PLANTED"
INFORMED SUBJECTS AND THOSE GROUPS NOT INFORMED

SUBJECTS	N	OVER 1 <i>syx</i>				OVER 2 <i>syx</i>				OVER 3 <i>syx</i>			
		Tot.	+	-	%	Tot.	+	-	%	Tot.	+	-	%
Groups with Primed Sub....	33	22	13	9	66.7	10	7	3	33.3	3	1	2	9.1
Other Uninformed Groups.....	21	11	7	4	52.4	8	5	3	38.6	4	3	1	19.4

These data reveal that the groups which were influenced by the "planted" informed persons made a larger percentage of statistically significant changes of one standard error of estimate. The other two groups, however, made larger percentages of changes greater than two standard errors. While this does not answer finally the question as to the effect of informed persons upon the attitudes of uninformed groups, it does indicate certain possibilities for further investigation when one considers that two-thirds of the persons under such conditions made changes of attitude. As a partial explanation for the fact that changes were no larger in size is the report of the observers in the groups who stated that the "informed" planted individuals lacked vital information concerning the solutions to the problems discussed. In fact one of these persons so antagonized members of his group that they became disgusted with his efforts to impress them.

Lastly, an analysis was made to determine whether the relationship between amount of information and size of change in opinion held good with uninformed subjects. The next table reports these data.

Because the persons were not informed on the question, the subject matter test scores were much lower in Experiment IV. In com-

paring average shifts on the grade divisions of 3, 4, and 5, the less informed subjects do not continue to follow the relationship observed in Experiment III in which less information was directly related to proportionately larger shifts of attitude. This breaks down at the subject matter test score of 5. Apparently, a point has been reached

TABLE XXI
RELATIONSHIP OF SUBJECT MATTER TEST SCORES AND SHIFTS IN ATTITUDE

EXPERIMENT NO. 2				EXPERIMENT NO. 4		
Subject Matter Test Scores						
	1	2	3	3	4	5
Av. Shift	1.45	1.66	1.97	.90	1.15	.50

at which the amount of information possessed is so slight as to be negligible as a factor in influencing attitude changes. Other factors besides information may be much stronger when such a point has been reached. With the small number of subjects in this experiment, no absolute or final conclusions can be drawn on this matter, however.

CONCLUSIONS

1. Experimental subjects made shifts of attitude amounting to statistical significance on both War and Capital Punishment problems; all discussion groups also showed significant changes of attitude.

2. Analysis of initial attitudes showed distinct skewing and setting of attitudes at the Strongly Opposed position, the most extreme attitude against Capital Punishment. This was probably due to the reading materials assigned in the bibliography on this question.

3. Initial Attitudes on War were grouped at the Strongly Pacifistic position, apparently a typical attitude for college students at the time of the experiments. These persons shifted quite readily to other positions, particularly to the Extremely Pacifistic position, as a result of group discussion.

4. A comparison of control and experimental groups showed that experimental subjects: (1) shifted from initial positions to a greater number of final positions; (2) made a greater percentage of changes in each initial attitude division; (3) made a greater range of shifts; (4) became more opposed to Capital Punishment; (5) became more pacifistic.

5. No typical pattern of the distribution of shifts in the discussion groups themselves was found to occur as a result of group discussion.

6. Analysis of individual shifts of men and women demonstrated that men made a larger percentage of large shifts and women a larger percentage of small shifts as a result of group discussion.

7. In groups heterogeneous as to sex, both men and women made a larger percentage of significant shifts than in homogeneous groups.

8. Men in homogeneous groups made a larger percentage of significant shifts than did women in like groups; in other words, men in men's groups shifted more than did women in women's groups.

9. There was practically no correlation between changes in attitude and the number of participations in discussion, the highest coefficient being .133 and the lowest —.092.

10. Argumentative and dogmatic persons in discussion made slightly larger changes of opinion than did cooperative and friendly individuals.

11. Persons making very large shifts of attitude were found to have components of temperament which marked them as being deficient in control and balance (low Normal) and characterized by emotional thinking and fluctuations of activity (high Manic and Depressive). Those making smaller significant shifts had higher Normal components, indicating greater control, and lower Manic and Depressive components.

12. Small shifts of opinion were found to be closely related to abundant information on a question whereas larger shifts accompanied lack of information.

13. Shifts of opinion from reading as shown in Experiment Three were greater than those produced by group discussion in any of the experiments.

14. Discussion tended to shift persons in the opposite direction from the change made after reading. Most significant explanations made for this by individuals were: (a) Discussion presented other points of view; (b) it supplied new and additional information. Persons shifting least in discussion were those who said that participation merely made them surer of their beliefs.

15. No very clear relationship was found to exist between intelligence and changes in attitude. Persons who were well-informed upon questions were, however, largely persons of superior intelligence. Since well-informed persons shifted least, there is some logical basis to indicate that individuals of high intelligence tend to make small changes of opinion. This conclusion must be qualified by the findings

in groups of high intelligence on the influence of temperament upon attitude changes.

16. Ninety-three per cent of the experimental subjects showed definite gains in information pertaining either to the background or the solution of the problems discussed.

17. From the reports of observers in the groups, it was learned that approximately three-fourths of the groups reached a consensus of opinion on solutions to the problems discussed.

THOMAS HART BENTON'S EXPUNGING SPEECH AN ANALYSIS OF THE IMMEDIATE AUDIENCE

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WHEN the United States Senate on March 28, 1834, by a vote of 26 to 20,¹ passed the famous resolution censuring Andrew Jackson for his order to remove the federal deposits from the Second United States Bank,² the Honorable Senators set the stage unwittingly for one of the most dramatic speaking situations which ever took place in the United States Senate. For nearly three years later, on the 12th day of January, 1837, the Senate proceeded to a special order of the day, the resolution of Thomas Hart Benton of Missouri to expunge the previous vote of censure from the journals of the Senate.³

The resolution was supported by the Missouri Senator in an "elaborate, carefully prepared speech, chiefly eulogistic of General Jackson and his administration. . . ."⁴ Claude Bowers has suggested that the "old man, always a trifle pompous and stilted in his style, was never more so, but in his most extravagant praise he unquestionably spoke the language of his heart."⁵ When Benton had concluded, Dana of Maine spoke briefly in favor of the motion and yielded the floor to Grundy of Tennessee, on whose motion the Senate adjourned. But Benton's speech was not to be unanswered, and until the vote was taken four days later, "a discussion, partaking of great heat, party feeling . . . and personality . . . ensued."⁶

¹ *Register of Debates in Congress*, 23rd Cong., 1st sess., part 1, X, 1187.

² *Ibid.*, "Resolved, That the President, in the late executive proceedings in relation to the public revenue, has assumed upon himself authority and power not conferred by the constitution and laws, but in derogation of both."

³ Benton, a champion of Jacksonian democracy, committed himself irrevocably to the expurgation of the vote of censure "until he should succeed in the effort, or terminate his political life." *Thirty Years' View* . . ., D. Appleton and Company, New York, (1854-6), I, 428. The Missouri Senator had brought the resolution to the attention of the Senate on three previous occasions, but a Whig majority had voted the the motion down on one occasion and had directed that it be laid on the table on the other two occasions. *Register of Debates in Congress*, *op. cit.*, part 2, p. 2128; *ibid.*, 2nd sess., part 1, XI, 727; *ibid.*, 24th Cong., 1st sess., part 2, XII, 1598.

⁴ Nathan Sargent, *Public Men and Events* . . ., J. B. Lippincott and Co., Philadelphia, (1875), I, 332.

⁵ Bowers, Claude, *The Party Battles of the Jackson Period*, Houghton Mifflin Company, New York, [c. 1922], p. 462-3.

⁶ Sargent, *op. cit.*, 298.

On the following day the Senate continued its consideration of the special order, and Dana, entitled to the floor, spoke first. Possessed of "neither inclination nor skill for public debate,"⁷ Dana spoke of the previous vote of censure as a "burlesque on judicial trials."⁸

Preston of South Carolina opened the debate for the opposition. It is significant that in this first utterance of the opposition they acknowledged the hopelessness of their task. Preston injected the first note of open bitterness into the debate as he declared:

But, sir, I have done. The argument is exhausted; the verdict has been rendered . . . the axe is in your hands. . . . I would declare . . . that I would rather be the criminal of 1834 than the executioner of 1837. Proceed, gentlemen, do your holy work.⁹

The argument of Preston was concluded on a no less scornful level as he looked about and saw

in the countenances of many honorable gentlemen that they would gladly avoid this thing, and would, if they could, avoid the deed. . . . Ay, sir, I believe that when it comes to the actual performance of the tragedy, there will be a secret whisper in their ear that will say to them, perhaps in this case our party feelings have pressed us a little too far.¹⁰

Rives of Virginia continued the debate for the expungers, accepting in a lengthy speech the challenge of Preston.¹¹ The speech was never reported in full, although from the remarks of Moore¹² of Alabama in the following speech, Rives alluded to the practice of certain state legislatures instructing their senators to favor expurgation.¹³

Niles of Connecticut spoke next with "an air of ease and satisfaction that bespoke a . . . consciousness of victory,"¹⁴ and wished that he could "send fire from heaven and consume the desecrated page."¹⁵ This flash of eloquence of Niles' motivated Moore to resume

⁷ In Dana's speech, *Register of Debates in Congress*, *op. cit.*, 2nd sess., part 1, XIII, 391.

⁸ *Ibid.*, 394.

⁹ *Ibid.*, 398.

¹⁰ *Ibid.*, 405.

¹¹ *Ibid.*

¹² One source states that Moore moved an adjournment at this time, the motion being defeated: 14 yeas, nays not counted. *Niles Weekly Register*, LI, (Jan. 21, 1837), 350.

¹³ *Register of Debates in Congress*, 405. Also see, Benton, *op. cit.*, 717; Bowers, *op. cit.*, 81; remarks of Preston, in *Register of Debates in Congress*, *op. cit.*, 397; remarks of Niles, *op. cit.*, 409.

¹⁴ Benton, *op. cit.*, 728.

¹⁵ *Register of Debates in Congress*, *op. cit.*, 416.

the floor and to suggest rather mockingly "a very important and useful amendment . . . that this record of the Senate's proceedings . . . be destroyed by fire to be extracted by means of a sun-glass."¹⁶ At this point Moore made two unsuccessful motions to adjourn.

The "great opposition leaders" had remained silent. Benton explained:

In the beginning, they had not considered the expunging resolution a serious proceeding: as it advanced they still expected it to miscarry on some point: now the reality of the thing stood before them. . . . They broke silence, and gave vent to language which bespoke the agony of their feelings.¹⁷

John C. Calhoun rose and addressed the Senate in a speech which was typical for its carefully measured logic:

The constitution requires the Senate to keep a journal; this resolution goes to expunge the journal; if you expunge a part, you may expunge the whole; and if it is expunged, how is it kept? . . . They tell us that the resolution is not to be expunged, but it is only to be endorsed "Expunged." Really, I do not know how to argue against such contemptible sophistry. . . .¹⁸

The speech was concluded with mingled futility and disgust as the South Carolinian asked: "But why do I waste my breath? I know it is all utterly vain. The day is done; night approaches, and night is suitable to the dark deed we meditate."¹⁹

A spectator in the galleries that day is authority for the report that Calhoun,

. . . who had sat all day in his seat, scarcely moving . . . an expression of unusual gravity pervading his sallow countenance . . . slowly rose, in the dim twilight, and, standing a minute or two, as if to collect himself, spoke in a calm, deliberate, and impressive manner. Every ear was open, and every eye intent upon the speaker. . . .²⁰

After Calhoun concluded, a successful effort was made to adjourn when Henry Clay announced his intention to speak at length upon the resolution.

Some time during the day of January 14, the expungers agreed to have a meeting for the purpose of unifying their efforts. They were agreed upon the expurgation, but differed upon the mode. During the evening they met at the Boulanger restaurant, "giving to the assemblage the air of convivial entertainment." It was finally agreed to inclose the resolution of censure within black lines and to write across its face: "Expunged by order of the Senate, this —— day of

¹⁶ *Ibid.*, 416-7.

¹⁷ Benton, *op. cit.*, 728.

¹⁸ *Register of Debates in Congress, op. cit.*, 418.

¹⁹ *Ibid.*

²⁰ Sargent, *op. cit.*, 334.

January, —." A solemn pledge was exacted from each senator that there would be no adjournment after the resolution had been called up on Monday until it had been passed. Benton,

. . . expecting a protracted session, extending through the day and night, and knowing the difficulty of keeping men steady to their work and in good humor, when tired and hungry . . . took care to provide, as far as possible, against such a state of things; and gave orders that night to have an ample supply of cold hams, turkeys, rounds of beef, pickles, wines and cups of hot coffee, ready in a certain committee room near the Senate chamber by four o'clock on the afternoon of Monday.²¹

On Monday the 16th the discussion was opened at the appointed time, and immediately a debate of long speeches, chiefly on the anti-expurgation side, opened itself upon the question.²² The debate dragged on and it appears that at first the opposition senators were "not dreaming that the President's friends were serious in their intentions to force a vote before retirement."²³

"With his usual eloquency, but in vain . . .," Henry Clay opened the debate and poured out his "contempt upon the slavish spirit of the expungers."²⁴ Clay recapitulated his original arguments in favor of censure, including a statement as to the constitutionality and propriety of the act, after which he advanced his reasons for considering the expunging of his resolution as an exemplification of the doctrine of "passive obedience."^{25, 26} Clay, who "seemed to feel that the end of the republic was at hand,"²⁷ unloosed all the art of his sarcasm as he animadverted upon the deed to be done:

. . . that foul deed which, like the blood-stained hands of the guilty McBeth, all ocean's waters will never wash out. Proceed, then, to the noble work which lies before you, and, like the skilful executioners, do it quickly. And when you have perpetrated it, go home to the people, and tell them what glorious honors you have achieved for our common country.²⁸

The expungers were represented next by Buchanan of Pennsyl-

²¹ In the account of the democratic caucus, the writer has followed the narrative of Benton, *op. cit.*, 727.

²² *Ibid.*

²³ William L. Royall, *Andrew Jackson and the Bank of the United States . . .*, *Economic Monographs*, No. XIX, G. P. Putnam's Sons, New York, (1880), 29.

²⁴ Samuel Mosheim Schmucker, *The Life and Times of Henry Clay*, J. E. Potter and Company, Philadelphia, (1869), 128.

²⁵ Carl Schurz, *Life of Henry Clay*, Houghton, Mifflin and Company, New York, (1891), II, 102.

²⁶ *Ibid.*

²⁷ Joseph Morgan Rogers, *The True Henry Clay*, J. B. Lippincott Company, Philadelphia, (1905), 261.

²⁸ *Register of Debates in Congress, op. cit.*, 439.

vania, who explained with considerable moderation that he was not being actuated by a "desire to obtain a miserable, petty, personal triumph. . . ." ²⁹ The debate was continued by Bayard of Delaware, who was "strong in zeal and ability," ³⁰ and who thought that the expunging resolution contained "an infinite deal of nothing." ³¹

When Bayard had concluded, Hendricks of Indiana, in a speech notable for its mildness, explained that in his opinion the act of expunging was one which the constitution would neither warrant nor defend. ³²

Strange of North Carolina gave the final speech of the expungers. After pointing out his lack of sympathy with certain statements in the preamble of the resolution, Strange said that he agreed, nevertheless, upon the justness, constitutionality, and propriety of the act. He wished, for example, to strike out the word "unconstitutional" and to insert the words "unauthorized by the constitution." ³³ Benton was not "at all tenacious on the subject; and he agreed to accept the amendments." ³⁴

A speech by Ewing of Ohio followed Benton's acquiescence in the amendments of Strange. Ewing, an opponent of expurgation, was one of the group of speaking senators whom Benton had called "able speakers—some effective, some eloquent. . . ." ³⁵ After commenting upon the "extreme lateness of the hour," Ewing spoke at length against the proposed expurgation. When Ewing had concluded, the Senate adopted the amendments previously suggested by Strange.

During the debate:

The committee room had been resorted to in parties of four and six at a time, always leaving enough on watch: and not resorted to by one side alone. The opposition were invited to a full participation—an invitation of which those who were able to maintain their good temper readily availed themselves; but the greater part were not in a humor to eat any thing—especially at such a feast. ³⁶

A member of the galleries recorded that "several Senators showed by their actions that they were not members of the . . . Congressional Temperance Society. . . ." ³⁷

²⁹ *Ibid.*, 457.

³⁰ Benton, *op. cit.*, 727.

³¹ *Register of Debates in Congress, op. cit.*, 466.

³² *Register of Debates in Congress, op. cit.*, 466.

³³ *Ibid.*, 484.

³⁴ *Ibid.*, 485.

³⁵ Benton, *op. cit.*, 727.

³⁶ *Ibid.*, 727.

³⁷ Benjamin Perley Poore, *Perley's Reminiscences of Sixty Years in the National Metropolis . . .*, Hubbard Brothers, Philadelphia, (1886), I, 141-2.

When Ewing concluded, a long pause indicated that the debate had closed. But as the question was about to be put, Daniel Webster rose slowly.³⁸ An eye witness wrote that his "deep-toned voice seemed almost sepulchral," and that his "dark visage assumed a darker hue."³⁹ Webster protested "against the manner of this proceeding, against its object, against its form, and against its effect."⁴⁰ Speaking in behalf of all the opponents of expurgation, Webster said:

We collect ourselves to look on, in silence, while a scene is exhibited which, if we did not regard it as a ruthless violation of a sacred instrument, would appear to us to be little elevated above the character of a contemptible farce.

This scene, we shall behold, and hundreds of American citizens, as many as may crowd into these lobbies and galleries, will behold it also: with what feelings I do not undertake to say.⁴¹

Midnight was now approaching. The following is Benton's account of the happenings:

. . . Mr. Webster was yet reciting his protest, two senators from the opposite side, who had been best able to maintain their equanimity, came round . . . and said "This question has degenerated into a trial of nerves and muscles. . . . We see that you are able . . . to carry your measure; so call the vote as soon as you please We shall say no more." Mr. Webster concluded. No one rose. There was a pause, a dead silence was invaded by a single word "question" . . . rising from the seats of different senators.⁴²

Benton moved that the blanks in the resolution be filled in by inserting the 16th day of January, and demanded the yeas and nays on the vote to be taken. The resolution was agreed to by a party vote of twenty-four to nineteen.⁴³

Asbury Dickens, the Secretary of the Senate, was sent for the journal. The return of Dickens with the journal, and the culmination of Benton's resolution is described by Henry A. Wise of Virginia, a witness to the event:

It was brought and laid upon the desk . . . and just at that moment every senator opposed to expunction, except Judge White, rose from his seat and

³⁸ Benton, *op. cit.*, 730.

³⁹ Sargent, *op. cit.*, 341.

⁴⁰ *Register of Debates in Congress, op. cit.*, 502.

⁴¹ *Ibid.*

⁴² Benton, *op. cit.*, 730.

⁴³ *Register of Debates in Congress, op. cit.*, 505. Yeas—Messrs. Brown, Benton, Buchanan, Dana, Ewing of Illinois, Fulton, Grundy, Hubbard, King of Alabama, Linn, Morris, Nicholas, Niles, Page, Rives, Robinson, Ruggles, Sevier, Strange, Tallmadge, Tipton, Walker, Wall, Wright. Nays—Messrs. Bayard, Black, Calhoun, Clay, Crittenden, Davis, Ewing of Ohio, Hendricks, Kent, Knight, Moore, Prentiss, Preston, Robbins, Southard, Swift, Tomlinson, Webster, White.

began to move out, Mr. Benton making the most derisive and scornful exclamations as they made their exit . . . the clerk opened the journal at the page of the resolution of censure; it seemed to resist the opening, the book was still, and it shut together again, until pressed open wide, and the page so held as to lay upon it the rule by the straight edge of which the black lines were to be drawn.⁴⁴

Evidently Benton could not constrain himself, for the moment was disturbed by his rising from his seat and "ostentatiously congratulating persons in the lower gallery on the triumph of his resolutions. . . ."⁴⁵

THE NON-SPEAKERS

Forty-three senators answered the roll-call vote on the expunging resolution. Sixteen of these senators had delivered speeches. The remaining senators either did not speak or were content to limit their remarks to moving for adjournment, such as Grundy of Tennessee and Southard of New Jersey. The actual debate, therefore, was restricted to approximately one-third of the senators. Yet, certain of these non-speakers were active in other ways. Benton mentions that in the caucus at Boulanger's, Wright of New York and Linn of Missouri were invaluable for their "resourceful conciliation."⁴⁶ It seems probable that others on both sides of the controversy were active in the techniques of the committee room.

THE PRESIDING OFFICER

William King, a Senator from Alabama, was in the chair on the 16th when the resolution was expunged.⁴⁷ Although none of the

⁴⁴ Wise, Henry A., *Seven Decades of the Union* . . ., J. B. Lippincott and Company, Philadelphia, (1881), 143.

⁴⁵ Benton, *op. cit.*, 730. Certain speeches delivered during the expunging debates were omitted in the *Register of Debates in Congress*, the source followed in this analysis of the speaking audience. The other sources, however, omit the mention of other speeches included in the *Register*. Which of the accounts to follow becomes partly a matter of convenience, and the *Register* was employed because of its more complete reporting of the majority of the speeches. An examination of the other primary sources of the period indicates the following omissions: John J. Crittenden of Kentucky spoke on the 12th in opposition to Benton's resolution, *Niles' Weekly Register*, LII, (March 25, 1837), 330. Preston spoke twice on the 13th, *ibid.* The *Congressional Globe*, 24th Cong., 2nd sess., XIII, 98, states that Dana spoke on the 16th and that Buchanan spoke twice on that day. The same source records that Bayard moved an adjournment on the 16th, the motion being defeated 28 to 16.

⁴⁶ Benton, *op. cit.*, 727.

⁴⁷ *Register of Debates in Congress*, *op. cit.*, 505.

contemporary accounts of the expunging debate indicate the presiding officer on the 12th and 13th, it is likely that King presided throughout the discussion. Martin Van Buren, but six weeks from the presidency was probably more concerned with the coming inaugural than with his duties as chairman of the Senate. King, thoroughly Jacksonian in his views, had voted against both the recharter of the bank and Clay's resolution of censure. Although having a friend in the chair could not have hindered the cause of Benton, there is no indication that King was partial in his handling of the debate. The speakers on both sides were alternately recognized in accordance with parliamentary custom, and it is perhaps a tribute to the presiding officer that during a long debate characterized by vituperative oratory there were no appeals from the decision of the chair.

THE GALLERIES

The senate chamber of 1837 was "admirably suited" for the deliberations of that day: "Modeled after the theatres of ancient Greece, it possessed excellent acoustic properties, and there was ample accommodation in the galleries for the few strangers who then visited Washington."⁴⁸ When Perley Poore wrote in this fashion of the "ample accommodation" of the galleries, he could hardly have been thinking of the debate on the 16th of January, 1837. As the debate continued, one observer noted

the crowd in the galleries becoming densely packed, and every inch of the Senate floor being occupied by members of the House and by ladies who had been admitted by the courtesy of the Senate. The scene was grand, impressive, and imposing: it was even solemn. It seemed as if some terrible rite was to be performed, some bloody sacrifice about to be made upon the altar of Moloch.⁴⁹

Benton wrote of the chamber on the 16th as being crowded with members of the House, and of the lobbies and galleries as being filled to their utmost capacity by visitors and spectators.⁵⁰

An "old line Whig," who confessed that he could not relate past events with "exact impartiality," recorded that the sympathies of four-fifths of those present were arrayed against the expungers.⁵¹ Although the estimate may be biased, it is certain that the audience in the galleries included those who were bitterly opposed to this obliteration of the record. As soon as the expurgation took place,

⁴⁸ Poore, *op. cit.*, 63.

⁴⁹ Sargent, *op. cit.*, 337.

⁵⁰ Benton, *op. cit.*, 727-8.

⁵¹ Sargent, *op. cit.*, 339.

"hisses, loud and repeated, were heard from various parts of the galleries."⁵² One writer has stated that this was "no new thing. Throughout all the many debates that had taken place the Bank had not hesitated to fill the galleries with its retainers to manifest approbation when its friends spoke, and disapprobation when its enemies spoke."⁵³ King, in the chair and sensible of senatorial decorum, ordered that the galleries be cleared. Benton spoke of the commotion as a "storm of hisses, groans, and vociferations."⁵⁴ He was on his feet immediately saying:

I hope the Sergeant-at-arms will be directed to enter the gallery, and seize the ruffians, ascertaining who they are in the best way he can. Let him apprehend them, and bring them to the bar of the Senate. Let him seize the bank ruffians. . . . Here is one just above me, that may easily be identified—the bank ruffians!⁵⁵

Benton's request was granted, and the Sergeant-at-arms was directed to proceed into the galleries. In a very few minutes the Sergeant-at-arms returned, and reported to the chair that he had arrested one of the disturbers.⁵⁶ The arrested individual was Mr. Lloyd, a practicing lawyer of Cleveland, Ohio.⁵⁷ Considerable confusion prevailed, and Benton, having seen the man "presented in this public manner," was not disposed to push the proceedings any further, and therefore moved that he be discharged from custody. But Mr. Lloyd was not willing to conclude the event in this manner and he announced through Robinson of Illinois that he was willing to be sworn and to undergo questioning. However, the motion for his discharge being pressed, the question was put and voted affirmatively, twenty-three to one. But Mr. Lloyd had not finished. "Mr. President," he said, "am I not to be permitted to speak in my own defence?" King, however, had finished, and turning to the Sergeant-at-arms, his laconic reply was, "Take him out." The Senate then adjourned.⁵⁸ A week later Lloyd published a letter requesting that judgment be withheld until due deliberation should enable him "to determine upon the course most proper to be pursued in relation to this outrage on the rights of An American Citizen."⁵⁹

⁵² *Register of Debates in Congress, op. cit.*, 505.

⁵³ *Royall, op. cit.*, 30.

⁵⁴ *Benton, op. cit.*, 731.

⁵⁵ *Register of Debates in Congress, op. cit.*, 505.

⁵⁶ *Ibid.*

⁵⁷ *Poore, op. cit.*, 142.

⁵⁸ *Register of Debates in Congress, op. cit.*, 505.

⁵⁹ *Niles' Weekly Register, op. cit.*

CONCLUSION

The fate of the expunging resolution was fixed in 1836 when the national electorate returned Jackson to the White House. It is highly probable that the oratory in the Senate neither changed any votes on the floor nor shifted any sympathies in the crowded galleries. Although the expungers had the numbers, their opponents had the talent. Calhoun, Clay, Webster, Preston and others delivered able and logical speeches.

In analyzing the audience in the galleries two conclusions appear reasonable. First, the crowd grew as the debate progressed. It is likely that the smallest audience heard Benton on the 12th, and that as interest increased, the galleries were filled in proportion. Second, the holding of the debate in an environment of conservative Washington society would suggest a majority opposed to expurgation. In any event those who deplored the deed voiced their objections.

SEX DIFFERENCES IN DISCUSSION

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THE effect of group discussion upon the amount and quality of group output has been considered in several studies. While most have tended to indicate that discussors are superior to non-discussors in amount or quality of output, there has not been in all instances an analysis of the data from the point of view of possible sex differences. Munsterberg,¹ it is true, reported men more efficient than women in determining the number of geometric figures on cards. As Burt² has pointed out, however, Munsterberg's male groups were probably superior in average native ability and maturity. Consequently, one would expect superior work from them. Burt,² because of his doubts concerning the equivalency of Munsterberg's groups, examined the effect of discussion on correctness of judgments of guilt. He found no significant sex difference. South³ reported certain sex differences in discussion outcomes. He found:

1. Committees composed of individuals of one sex more efficient than mixed groups when working on concrete and personal tasks.
2. Women better than men in interpreting photographs.
3. Women quicker than men on bridge problems but similar to men in accuracy.
4. Women faster but less accurate than men on multiple choice problems.
5. Women quicker and more accurate than men in judging English compositions.

Many of these generalizations, however, appear from the data presented to be based on differences which are statistically unreliable. Jenness⁴ reported that women changed estimates of the number of beans in a bottle more than did the men whether or not discussion occurred. Gurnee⁵ found, when the task was collective learning in a maze situation, that groups of one sex or almost all of one sex were superior to mixed groups. From this review of studies that have

¹ Munsterberg, H. *Psychology and Social Sanity*, Doubleday Page, New York, (1914), 181-202.

² Burt, H. E., "Sex Differences in the Effect of Discussion," *J. Exper. Psychology*, 3, (1920), 390-395.

³ South, E. B., "Some Psychological Aspects of Committee Work," *J. Appl. Psychol.*, 11, (1927), 348-368, 437-464.

⁴ Jenness, A., "The Role of Discussion in Changing Opinion Regarding a Matter of Fact," *J. Ab. and Soc. Psychol.*, 27, (1932), 279-296.

⁵ Gurnee, H., "Maze Learning in the Collective Situation," *J. Psychol.*, 3, (1937), 437-443.

included a treatment of possible sex differences one is left in considerable doubt as to the prevalence of such differences in discussion.

It is the purpose of the present investigation to learn whether as a result of discussion in mixed groups there are sex differences in the quality of individual decisions on a social problem. Several questions will be considered:

1. After discussion which sex arrives at better decisions?
2. Which sex has the better decision scores one month following the discussions?
3. Do low general ability subjects of one sex gain more after discussion than the low general ability subjects of the other sex?
4. Do high general ability subjects of one sex gain more after discussion than the high general ability subjects of the other sex?
5. Is there a sex difference in the gains of individuals of initially poor performance?
6. Is there a sex difference in the gains of individuals of initially good performance?

MATERIALS AND PROCEDURE⁶

The materials for this experiment consisted of a problem for discussion, a measure of goodness of decision, and a pamphlet of factual information on the problem discussed.

The problem considered was: "What, if anything, should be done about Ohio's system of releasing convicts from prison?" This problem met the following criteria for a suitable experimental task: (1) It should be controversial. (2) It should be worthy of serious discussion. It should not be a task involving the determination of a fact or the solution of a puzzle. (3) It should be one for which the goodness of solutions could be determined. (4) It should be one on which the subjects are poorly informed. (5) It should be within the subjects' range of interest and comprehension.

The measure of goodness of solution or decision involved ranking five given solutions to the parole problem stated above. The good ranking was the ranking made by eleven experts highly informed in the field of parole. The rankings made by the subjects were converted into scores by summing the squared differences between the subjects' rankings and the good (experts') ranking. A score of zero then was a perfect score. The larger the score, the greater was the difference between the subjects' ranking and that of the experts.

⁶ Since the materials used and the procedure followed were identical with those reported in the author's "Decisions and Attitudes as Outcomes of the Discussion of a Social Problem," *Contributions to Education*, No. 777, Bureau of Publications, Teachers College, Columbia University (1939), there is no need for a detailed consideration of them here.

The pamphlet of factual information was prepared by the writer and mimeographed. It included factual information covering the systems involved in the alternative solutions. It was compiled from writings on the problem, from interviews with experts, and from correspondence with experts. Competent criminologists reviewed the pamphlet for accuracy and completeness.

The procedure in the experiment was as follows: On the first day after all subjects individually had studied the information pamphlet for forty minutes, the five solutions were ranked by each subject. On the basis of the resulting ranking scores and the general ability scores previously secured 78 boys were paired with 78 girls. These paired subjects were then placed on the second day into mixed discussion groups of four members—two boys and two girls. Aside from the sexual composition individuals were placed in the groups on a random basis. No leader was appointed for any group. The information pamphlet was available for reference. Each group had the group task of ranking the five solutions and giving reasons for the rankings. (These group rankings and reasons have not been used in the following statistical analysis; they were used to give purpose and direction to the group work.) After approximately thirty-eight minutes of discussion the subjects again as individuals ranked the five given solutions. One month later the subjects ranked the solutions a third time.

The 78 boys and the 78 girls were high school juniors and seniors enrolled in courses in American history and social problems. None had had any special training in discussion techniques. The paired students were selected from a larger group that had studied the information pamphlet. Since the groups were paired, they were equal in general ability scores and in ranking scores before discussion. The mean general ability score for each sex group as measured by the Ohio State University Psychological Test, Form 20 was 52.40 with a standard deviation of 20.45. The mean ranking score for each sex group before discussion was 9.21 with a standard deviation of 8.28.

RESULTS

A summary of the data is given in the accompanying tables. From the information contained in them the answers to some questions pertaining to sex differences in discussion may be considered.

Which sex arrived at the better decisions after discussion? From Table I it is evident that both groups made gains, the boys improving on the average 4.44 in ranking score and the girls 6.46. Both of these gains are reliable, the critical ratio of the boys' gain being 4.95 and

TABLE I
MEAN GAINS IN RANKING SCORES FROM BEFORE DISCUSSION TO (1) AFTER DISCUSSION AND (2) ONE MONTH LATER EVALUATED IN TERMS OF THE STANDARD ERRORS OF THE MEAN GAINS, 78 BOYS PAIRED WITH 78 GIRLS

ITEM	M_{gain}	σ	σ_n	C.R.
From before discussion to after discussion				
1. Boys.....	4.44	7.77	0.90	4.95
2. Girls.....	6.46	8.10	0.92	7.02
From before discussion to one month following				
1. Boys.....	3.31	8.96	1.02	3.02
2. Girls.....	4.51	10.13	1.56	3.90

TABLE II
MEANS OF DIFFERENCES BETWEEN GAINS OF 78 BOYS PAIRED WITH 78 GIRLS FROM BEFORE DISCUSSION TO (1) AFTER DISCUSSION AND (2) ONE MONTH LATER EVALUATED IN TERMS OF THE STANDARD ERRORS OF THE MEANS

BOYS' GAINS MINUS GIRLS' GAINS	M_{diff}	σ	σ_n	C.R.
From before to after discussion.....	-2.03	7.84	0.89	2.28
From before discussion to one month following.....	-1.20	10.03	1.14	1.05

that of the girls' being 7.02. With both sexes the mean gains are well over three times the size of the standard errors, the usual standard of significance. These gains are not surprising, for the writer in similar previous experiments found that similar students made reliable gains.⁷ However, we are interested here in possible sex differences. Subtracting the boys' mean gain of 4.44 from the girls' mean gain of 6.46, one finds that the girls in this experiment did gain on the average 2.03 more than the boys. Is this difference significant? The item in Table II showing the mean of differences between gains of the pairs indicates that the standard deviation of the mean of the differences is 7.84. The sigma of the mean is 0.89. The mean of the differences divided by the sigma of the mean gives a critical ratio of 2.28, somewhat less than the usual standard of significance. Such a critical ratio indicates that there are approximately 988 chances in 1000 that the obtained difference is a true difference rather than a chance one. Consequently, on the basis of the present evidence one must conclude that the gains of the girls, while larger than those of the boys, are not certainly significantly larger.

Which sex had the better scores one month following the discus-

⁷ Timmons, W. M. "Decisions and Attitudes as Outcomes of the Discussion of a Social Problem." *Contributions to Education*, No. 777, Bureau of Publications, Teachers College, Columbia University (1939).

sions? Table I indicates that the boys had average gains of 3.31 from the measurement taken before discussion to the one taken one month following the discussions. During the same period the girls had average gains of 4.51. If these gains are compared with those representing the gains from before to immediately following discussion, it is evident that, while both sexes lost part of their first gains, both were still superior to their scores before discussion. Reference to the critical ratios for these gains shows that even after one month the scores of both sexes on the average were significantly better than before the discussions occurred, for the critical ratios in both instances exceed three. There remains, however, the difference of 1.20 favoring the girls. The item in Table II showing the mean of the differences between the gains of the pairs from before discussion to one month following indicates that the standard deviation of the mean of the differences is 10.03. The sigma of the mean is 1.14. The mean of the differences in gains divided by the sigma of this mean gives a critical ratio of only 1.05, indicating that one month following the discussions there are only 85 chances in 100 that the mean of the differences in gains represents a true sex difference favoring the girls. On the basis of the present evidence there is some doubt of a persisting true sex difference in the goodness of decisions arrived at after discussion of a social problem.

TABLE III
MEANS OF DIFFERENCES IN GAINS AFTER DISCUSSION BETWEEN PAIRED SEX GROUPS HIGH OR LOW IN GENERAL ABILITY AND GOOD OR POOR IN INITIAL PERFORMANCE EVALUATED IN TERMS OF THE STANDARD ERRORS OF THE MEANS

BOYS' GAINS MINUS GIRLS' GAINS AFTER DISCUSSION	N	M _d ± t	σ	σ_m	C.R.
Low general ability: boys—girls . .	34	-2.41	8.79	1.51	1.60
High general ability: boys—girls .	30	-1.47	6.99	1.30	1.13
Initially good performance: boys—girls	30	-0.40	4.75	0.88	0.45
Initially poor performance: boys—girls	30	-3.47	10.57	1.96	1.77

Inasmuch as the present experiment shows no significant differences favoring either sex immediately after discussion or one month following the discussion, there is little reason to expect significant differences between sex groups high or low in general ability or between sex groups of good or poor initial performance. An inspection of the data summarized in Table III bears out this expectation. The mean of the differences between the gains of low ability boys (having raw scores on the Ohio State University Psychological Test,

Form 20 of 42 or less) and the gains of low ability girls was 2.41 favoring the girls. 34 pairs are here involved. The standard deviation is 8.79 and the standard error of the mean 1.51. The resulting critical ratio is 1.60, indicating that the difference favoring the low ability girls is not reliable.

As with the low ability girls, the high ability girls gained more, but not significantly more, than did the high ability boys. Thirty boys paired with 30 girls having raw scores on the Ohio State University Psychological Test, Form 20 of 53 or above are here considered. The mean of the differences between the discussion gains of these 30 pairs was 1.47 favoring the girls. The standard deviation was 6.99 and the standard error of the mean 1.30. The resulting critical ratio is 1.13, indicating again that the difference favoring the girls is not significant.

In addition, although the girls of both good and poor initial performance gained more from the discussion than similar groups of boys, the means of the differences are not reliable. Good initial scores are pre-discussion scores of four or less. Poor initial scores are pre-discussion scores of eight or more. Thirty pairs were involved in each comparison. The mean of the differences between the discussion gains of the 30 pairs of good initial performance was 0.40 favoring the girls. The standard deviation was 4.75, the standard error of the mean 0.88. The critical ratio of this mean of differences in gains is only 0.45, indicating that there are only 67 chances in 100 that this represents a real sex difference favoring the girls of good initial performance.

The findings are similar with reference to the thirty pairs poor in initial performance. The mean of the differences between the discussion gains of boys with poor pre-discussion scores and girls with poor pre-discussion scores was 3.47 favoring the girls. This is a larger difference than that found for any other general ability or initial performance group. The standard deviation of the distribution was 10.57 and the standard error of the mean 1.96. The critical ratio, however, is only 1.77, indicating that there are about 96 chances in 100 that this difference favoring the girls is a true difference.

DISCUSSION

The fact that both sex groups made gains after the discussion was not unexpected. It was expected, too, that both boys and girls would lose some of their gains after a lapse of time. Most previous studies, although for the most part using experimental tasks somewhat different from those facing discussion groups in life, have ar-

rived at similar findings. The findings of the present study tend to support those of Burr⁸ who found no significant sex difference in the effect of discussion on the correctness of judgments of guilt. One cannot be certain that the present findings throw doubt on South's⁹ conclusions that women are superior to men on certain discussion tasks, for the experimental task (a social problem) used in the present experiment appears to be very different from South's tasks.

The possibility, however, of girls being superior to men in quality of output should not be dismissed on the basis of this investigation. It must be remembered that in the present study the girls did make greater gains than did the boys, even though in the present instance these differences are not statistically significant. It is possible that other studies may find significant differences favoring the girls. For example, if one considers the mean of the differences between paired boys and girls of initially poor performance (3.47) as the mean of an infinite number of means distributed about it, eighteen of every one-hundred would be presumably of a size that would be statistically significant, granting the same standard errors as in the present instance (1.96). Also, if a larger number of paired subjects were used in such an experiment, significant differences might be found. There is, in any event, enough doubt remaining to make it advisable to conduct additional experiments with perhaps larger numbers of subjects.

Unless, however, subsequent research shows larger sex differences than those found in this experiment, it does not seem that one need worry a great deal about the ability of mixed discussion groups to do the tasks assigned to them. A difference of from one to three points, for example, in such scores as those involved in the present study would not appear to present an insurmountable obstacle to the discussion process and to the ability to profit from that process. There remains, however, the possibility that groups all of one sex might have done superior work to mixed groups. Gurnee,¹⁰ as we have pointed out, found such to be true when the task was collective learning in a maze situation. This possibility was not studied in the present investigation.

SUMMARY

Seventy-eight high school boys paired with 78 high school girls on the bases of general ability and decision score before discussion were placed in mixed discussion groups of two boys and two girls. Before

⁸ Burr, H. E., *op. cit.*, 390-395.

⁹ South, E. B., *op. cit.*, 440-449.

¹⁰ Gurnee, H., *op. cit.*, 437-443.

discussions, immediately following discussions, and one month after the discussions all students individually ranked five given solutions to the social problem discussed. The good ranking was a consensus of the rankings made by experts. The gains made by sex groups were studied.

1. Both boys and girls made reliable gains after discussion.
2. One month following the discussion, while both boys and girls had lost a part of their gains, both still had scores significantly better than their pre-discussion scores.
3. After discussion the girls had gained more than the boys, but the difference was somewhat less than the usual standard of significance.
4. One month following the discussion the girls had better scores than the boys, but again the difference was short of being statistically significant.
5. Low ability girls had larger gains after discussion than low ability boys, but the difference was not reliable.
6. High ability girls had larger gains after discussion than high ability boys, but again the difference was not reliable.
7. Girls with good pre-discussion ranking scores gained slightly, but not significantly, more than boys with good pre-discussion ranking scores.
8. Girls with poor ranking scores before discussion gained considerably more than boys with initially poor ranking scores, but once again the difference fell short of statistical significance.

THE SPECTRA OF MODEL LARYNX TONES

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THE Puff vs. Overtone controversy over vowel composition is well known. There is no point in reviewing it here. However, the controversy has encouraged many to think of inharmonic components in vocal sounds, if such components be assumed at all, as unrelated to the fundamental. While it is repeatedly accepted as obvious that certain defects of voice probably contain inharmonic elements, there is a tendency to consider these as independent of whatever harmonics are present. However, *it may be that in some cases harmonic and inharmonic partials bear definite relationships to each other and that these relationships are not due to chance.* Such a possibility is suggested by a recent investigation of the acoustic spectra characterizing model larynx tones. In this investigation phenomena were observed which, if their counterparts are subsequently found to occur in vocal tones, will influence vocal theory.

In determining the spectra of model larynx tones the procedure was as follows: a cushion-pipe model larynx was caused to vibrate under a variety of conditions.¹ The partials in the note produced were measured with an electrical analyzer of the degenerative type. Specifically, a General Radio 760A sound analyzer coupled to a General Radio 759B noise level meter was used. The entire assemblage was in an acoustically treated laboratory. Furthermore, the note to be analyzed was picked up 9 inches from the sound radiating orifice of the model. These two precautions minimized the contribution of standing wave patterns within the room. However, such standing waves may have had a minor influence on the intensity readings made during the experiment. Still this is a minor limitation since the present study was concerned primarily with the frequencies rather than with the absolute intensities of the components in the model larynx spectra.

An important feature of the analyzer which was used is that the instrument responds to all components, *whether harmonic or not*, whose frequencies lie between 25 and 7,500 cycles per second. To achieve this advantage, however, certain limitations must be accepted. Since five to ten minutes are required for each analysis, the instrument can be used only when the sound is maintained constant for this period of time. Consequently, the components in the resulting spec-

¹ Carhart, R., "Infra-glottal Resonance and a Cushion-pipe," *Speech Monographs*, 5, (1938), 65-90.

trum are average values. The method also ignores such aspects as vibrato fluctuations. Where the average spectra of steady state sounds are desired, however, its sensitivity to both harmonic and inharmonic components makes the degenerative analyzer a valuable tool.

It is fairly simple to maintain steady cushion-pipe tones for ten minutes or more. Hence, the degenerative analyzer is well suited to exploring such tones. During the present study about one hundred and fifty cushion-pipe spectra were determined. In obtaining the tones which were analyzed, different supply-tube and supra-cushion resonator adjustments were used, the strength of the exciting air stream and the pressure within the cushions were modified, and cushions of different weights and proportions were employed. The result was a sampling of spectra obtained under a wide variety of experimental conditions.

Typical of the spectra obtained are those illustrated graphically in Figures 1 and 2. In these figures each vertical bar represents a partial, its frequency being shown by its position along the abscissa. The height of the bar indicates in comparative terms the effective sound pressure of the partial. To explain: in each spectrum one component (the fundamental except in Spectra III and IV) was made the standard. The intensity of any other component in the spectrum is represented by the percent of effective sound pressure resident in that component as compared to the effective sound pressure in the standard, which was assigned a value of 100%. A partial was recorded only if its effective sound pressure was 1% or more of that for the standard. This means that each component recorded had an intensity which was not more than 40db below the standard for that particular spectrum. Components weaker than this were ignored.

Figure 1 contains spectra typical of those found when no resonator was above the vibrating cushions of the model. In contrast, the spectra shown in Figure 2 are typical of the results obtained when such a resonator was in place. Comparing these figures, one notes that more complex spectra characterize the sounds emitted in the presence of a supra-cushion resonator. A more significant fact, however, is that the six spectra illustrated are not all of the same type. They group themselves into three classes: (1) harmonic, (2) predominantly harmonic, and (3) predominantly inharmonic.

Spectra of the harmonic class, of which I, II and IV are examples, were found most frequently. Usually they contained few components: with the fundamental the strongest and the intensities of the higher partials dropping off progressively. However, as illustrated in Spectrum II, occasionally the first overtone carried the greatest amount

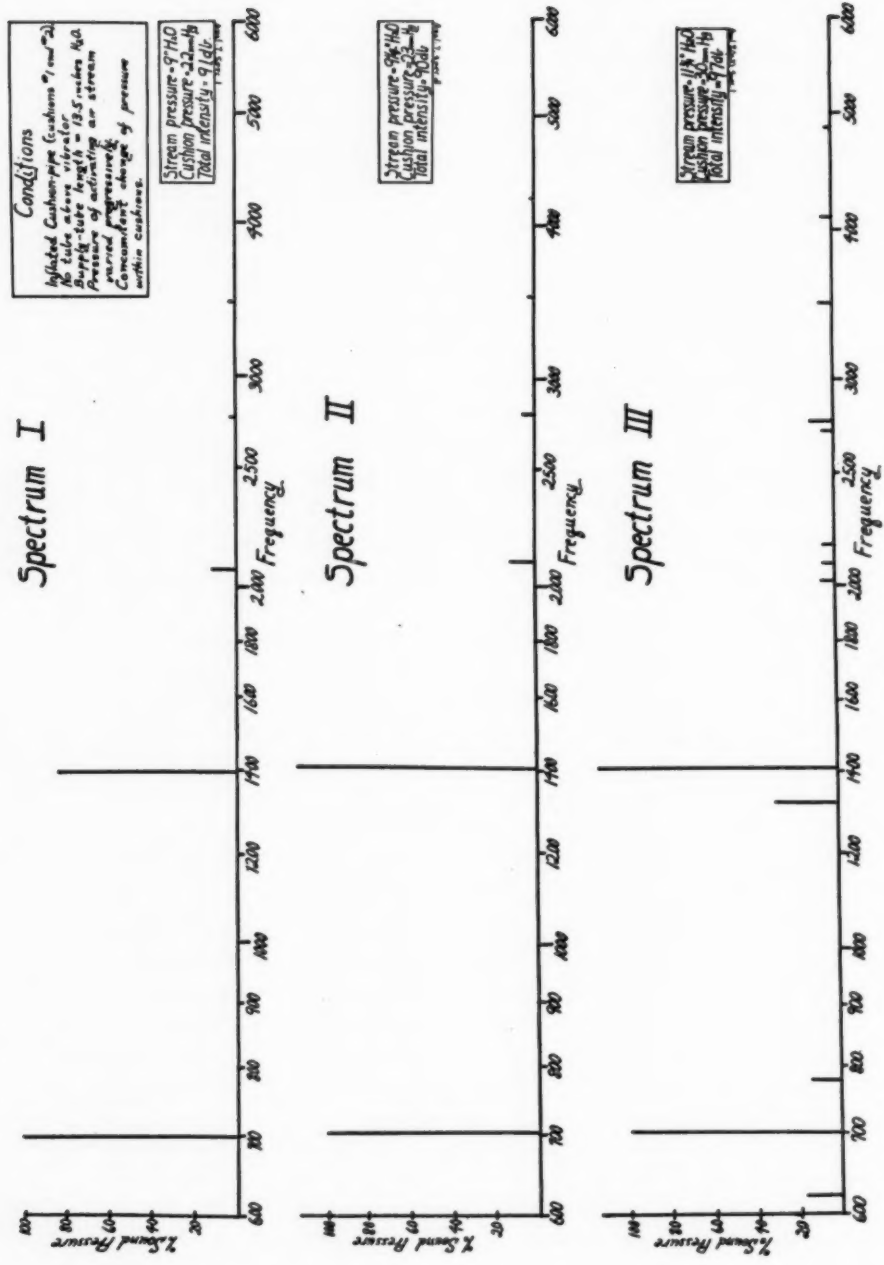


FIGURE 1
 Acoustic spectra of typical cushion-pipe tones obtained when a supra-cushion resonator was not a part of the model larynx system.

of energy. Spectra I and II were obtained when there was no resonator above the cushions. Adding such a tube produced the effect exemplified in Spectrum IV. Two changes are evident. First, the number of partials is increased. Second, except in the case of the first overtone, the higher partials were relatively stronger than in the preceding instances. These two phenomena are typical and are probably related. They suggest that the additional tube functioned as a resonator which selectively modified the sound emitted by the cushion-pipe system.

The second class is the predominantly harmonic. A spectrum of this type consists of a harmonic series plus one or two inharmonic partials. An example is Spectrum V. While much like Spectrum IV, it contains two inharmonics, which for convenience are labeled. Why such inharmonics should appear is not at present clear. They seem to bear no relation to other partials and do not occur often. To date, they have been found only when a resonator was above the cushions. Thus, it may be that these inharmonics depend in some way upon the supra-cushion resonance cavity.

The third class is the predominantly inharmonic. Typical of it are Spectra III and IV. Spectrum III, obtained with the tube above the cushions removed, shows a short harmonic series similar to those in Spectra I and II. In addition, however, there are a large number of inharmonics. Several of these cluster about the lower harmonics, but others are isolated higher partials which are not integral multiples of any lower frequency component. Turning to Spectrum IV, a similar pattern is noted. In this case a 9 6/10 inch supra-glottal tube had been added and other conditions had been changed. In other words, spectra in which inharmonics predominate were yielded under a variety of conditions. Particularly significant, however, are two additional facts. First, not all pairs of cushions could be induced to yield such spectra. Second, cushions which did produce them also emitted harmonic or predominantly spectra under other circumstances.

The most unique feature of predominantly inharmonic spectra is that in each instance the partials are related in a simple manner. The entire series of inharmonics can be explained by assuming three kinds of components: (1) a few primary frequencies, (2) their harmonics, and (3) summation and difference tones derived from combinations of the primary frequencies and/or their harmonics. What is meant is illustrated in Figure 3. Here is shown the break-down of four typical inharmonic spectra. Each of the upper three horizontal lines contains a single primary and its harmonics, if any. Thus, in line two appear components whose frequencies are integral multiples of the second

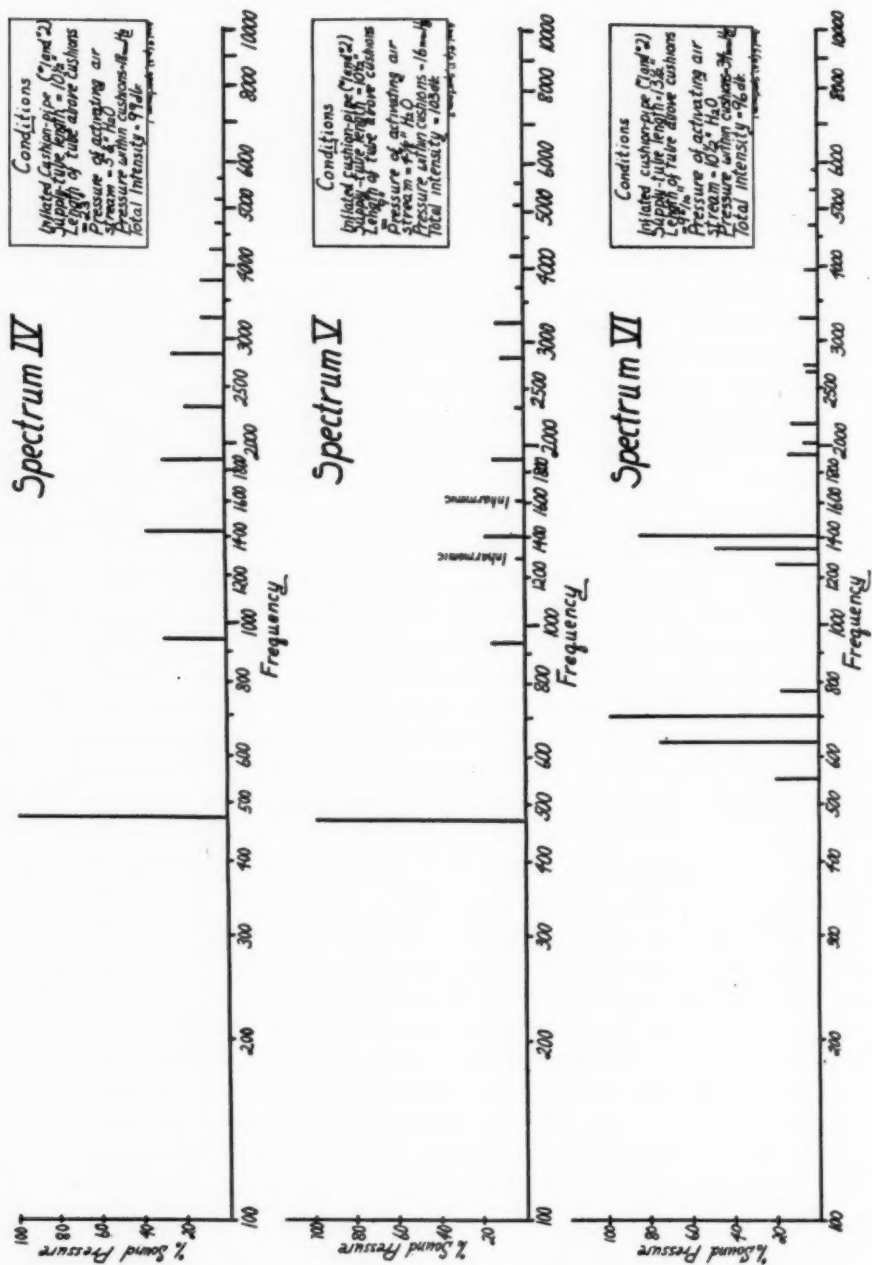


FIGURE 2
Acoustic spectra of typical cushion-pipe tones obtained when a supra-cushion resonator was included in the model larynx system.

primary frequency, for which f_2 is the symbol. The bottom three lines contain combination tones derived as indicated at the extreme left. For example, in line four are found combinations derived from f_1 and f_2 or their multiples. The exact values of the primary frequencies (f_1 , f_2 and f_3) varied with the spectrum. In the interests of simplicity these values are not shown.

The position of each component in its spectrum is represented by a number with a subscript. In the f_1 line, for example, appears $1_a = f_1$. Interpreted, this means that the first partial of the spectrum denoted by the subscript a is the primary frequency, f_1 . Other spectra are indicated by other subscripts. Thus, component 4 of spectrum c is $f_1 + f_2$, or the summation of the first two primary frequencies of spectrum c .

To further facilitate interpretation, similar combinations are grouped in the same square of the chart. Thus, both spectra c and d contain the combination $f_1 + 3f_2$. In spectrum c , however, this is the eighth component, while in spectrum d it is the ninth.

The patterns for the four spectra parallel one another closely. Each contains three base frequencies, a series of overtones of f_2 , and a series of *summation* tones in which f_1 combines with f_2 and its multiples. Many possible combinations are absent. For example, no harmonics of either f_1 or f_3 were observed. Similarly, only two combinations of f_1 and f_3 are shown, and in each case there is an alternate possibility. Moreover, the only time a combination of f_2 and f_3 appears there is an alternate f_1 and f_3 possibility. Finally, all the combination tones found in these four spectra are summation tones. While this does not hold without exception for the inharmonic spectra obtained during the present study, most of the combinational components are of the summation variety.

A word should be said about the fact that harmonics of f_2 appear while those for f_1 and f_3 do not. The explanation probably rests on the fact that in the instances here shown f_2 was by far the strongest of the three primary frequencies. From this it can be reasoned that only the harmonics of f_2 were strong enough to appear separately and in combination.

The implications of what has been described are interesting. It will be recalled that every acoustical system has an electrical analogue, that many problems in theoretical acoustics are solved by means of equivalent electrical circuits. Therefore, there is justification in searching for an electrical system which yields spectra similar to the predominantly inharmonic ones described above. In this connection two possible analogues present themselves. One is a non-linear trans-

ducer into which two or more frequencies are simultaneously fed. The other is a system of two or more electrical oscillators tuned to different frequencies and coupled through non-linear elements. In both these instances the critical conditions are: first, non-linearity in the system and, second, the imposing of two or more primary frequencies on the system. By analogy one may conclude that the cushion-pipe model larynx contains at least one non-linear element and that, as a result, combination tones are produced when the model's behavior is such as to yield several primary frequencies.

This leads to the question, "What is the site of the non-linearity?" In all probability the non-linearity is a function of the series of puffs released by the vibrating cushions. These sound initiating puffs are unidirectional. They move in a train which recedes from the cushions. We have here a condition admirably suited to non-linear transduction.

Making this assumption, however, does not mean that all sounds produced by the model must contain combination tones. These latter will occur only when the pattern of periodic fluctuations imposed on the out-flowing air stream contains more than one primary frequency. Since the vibrating cushions are the bodies which periodically interrupt the air stream, a safe assumption seems to be the following: the model yields combination tones when conditions are such that two cushions which are not well matched are vibrating at different frequencies rather than at the same frequency. Thus, we might explain the primary frequencies in the predominantly inharmonic spectra discussed earlier by saying that f_1 was the frequency of one cushion and f_2 of the other. Differences in intensity can be attributed to differences in the amplitude of cushion vibration. Then, f_2 is the frequency depending on the more active cushion, f_1 on the less active one. (Incidentally, such differences in the amplitude of cushion vibration have been observed.) Under such circumstances, the non-linearity of the puff train would lead to the formation of combinations of f_1 and f_2 .

The source of f_3 is more obscure. Two possibilities exist. One is that an additional cavity frequency is present. The other is that f_3 is not a primary frequency but rather a combination tone, namely, $2f_2 - f_1$. In fact, Figure 3 shows f_3 as a primary only because this allowed the seventh components of spectra *a*, *b*, and *c* as well as the eighth of spectrum *d* to appear as $f_1 + 2f_3$ rather than as $4f_2 - f_1$, which otherwise would have been necessary. However, since the latter combination is not far-fetched, a third primary is not essential. In other words, the inharmonic spectra being discussed could as easily as not have been broken down into f_1 and f_2 plus harmonics and

combination tones thereof. The important thing is that at least f_1 and f_2 must be assumed as primaries. These can be considered the frequencies at which the cushions vibrated. One concludes that spectra exhibiting combination tones occur when two mismatched cushions are functioning at different frequencies. Other as yet unsuspected factors may also be involved, but at least the aforementioned is essential.

Since the cushion-pipe model is set up as an analogue of the human vocal mechanism, the findings of the present study suggest the possibility that combination tone spectra may be characteristic of some types of phonation. Whether or not this is the case can not at present be stated definitely, although there are clues suggesting that it is. The predominantly inharmonic tones emitted by the model larynx are perceived by a listener as being similar to the hoarse vocal note heard when a bit of excess mucous gets on one of the vocal folds. The peculiar hoarseness occurring under such circumstances might be explained by assuming that the excess mucus introduces a differential loading such that the two folds vibrate at different frequencies. The unpleasantness of the heard sound then could be attributed to the presence of inharmonics consisting of at least two primary frequencies and several combination tones.

In closing, one point should be made clear. It is not to be implied that all vocal sounds contain combination tones. Such tones, if they exist at all, occur only in certain abnormalities of voice. The significant thing is that they represent a type of inharmonic which has been given scant consideration in discussions of vocal acoustics. There is need for further study aimed at discovering if combination tone spectra are at times yielded by the human mechanism. At present, all that can be said is that the cushion-pipe occasionally does produce such spectra and that by analogy they might be expected in some types of voice.

AN EXPERIMENTAL STUDY OF THE DURATIONAL CHARACTERISTICS OF THE VOICE DURING THE EXPRESSION OF EMOTION

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IN a previous report (*Fairbanks and Pronovost*¹) objective data were presented on the pitch characteristics of five vocally simulated emotions. The present paper is concerned with the durational features of the same simulations.

I. EXPERIMENTAL PROCEDURE

Since the first publication included a detailed description of the procedure, a summary only will be given here. The major aspects were the following.

1. Five emotional states—contempt, anger, fear, grief, indifference—were studied.

2. The same test passage was employed for simulation of all five emotions. This passage, 27 words in length, and capable of assuming various emotional meanings according to the vocal interpretation, was:

"There is no other answer. You've asked me that question a thousand times, and my reply has always been the same. It always will be the same."

3. Using this passage, six versatile, amateur male actors, 20-30 years of age, each simulated the five emotions in turn. High-quality phonograph recordings were made.

4. In order to determine the degree to which the simulations exemplified the emotions which they purported to portray, the 30 recordings, five readings by each of the six actors, were played in random order before a group of 64 young adults. These observers did not know what emotions were being simulated, and, to prevent them from deducing that only five different emotions were concerned, additional ambiguous recordings were distributed throughout the random order. As each recording was played the observers, indi-

¹ Fairbanks, G. and Pronovost, W., "An Experimental Study of the Pitch Characteristics of the Voice during the Expression of Emotion," *Speech Monog.*, 6, (1939), 87-104.

vidually, selected from a list of 12 emotional states, containing the five listed above, the term which seemed to name most accurately the emotion being simulated. In view of the various precautions it is believed that this identification task was certainly no easier and probably more difficult than procedures employed previously in studies of facial expression.

5. The judgments disclosed that most of the simulations were highly satisfactory examples of the intended emotions. Considering the six actors as a group, the percentages of correct identifications by

TABLE I
MEASURES OF RATE. PHONATION ONLY, PHRASES ONLY, TOTAL SPEAKING TIME.
DURATION IN SECONDS, RATE IN WORDS PER MINUTE. ALL VALUES ARE MEANS

	CON- TEMPT	ANGER	FEAR	GRIEF	INDIF- ERENCE
Phonation					
Total Duration.....	9.34	5.80	5.50	6.61	5.45
Duration per Word.....	.35	.22	.20	.25	.20
Rate.....	174	279	295	245	297
Phrases					
Total Duration.....	11.22	6.96	6.50	8.96	6.40
Rate.....	144	233	249	181	253
Total Speaking Time					
Total Duration.....	14.03	8.51	8.03	12.57	7.74
Rate.....	116	190	202	129	209

the observers were as follows: contempt, 84; anger, 78; fear, 66; grief, 78; indifference, 88.

6. For the physical division of the experiment, both fundamental frequency and duration measurements were made by means of a modified oscillograph which permits sound-wave photography from phonograph recordings and highly reliable measurements of these two aspects of sound.²

II. RESULTS³

Rate. Table I presents the data on three different concepts of speaking rate. Using the values for contempt as examples, the table may be interpreted as follows: First, the mean total duration of phonation was 9.34 sec., i.e., the average simulation involved 9.34 sec. of vocal cord vibration. The second row gives the mean duration per

² The most recent modification and description of this instrument has been made by Cowan, M., "Pitch and Intensity Characteristics of Stage Speech," *Arch. Sp.*, 1, (1936), Suppl., 1-92.

³ No attempt is made in this report to consider variability among the six actors. A subsequent paper will discuss such differences, both in pitch and duration, as they may be related to variations in identifiability of the portrayals.

word, an average of 0.35 sec. during the portrayals of contempt. The mean rate, phonation only being considered, was 174 words per minute. The next row adds pauses *within* phrases to the values of the first row, a total phrasal duration of 11.22 sec., with a corresponding rate in words per minute of 144. The third group of measures concerns the total speaking time, the traditional method of calculating rate, and shows that the average simulation of contempt was accomplished in 14.03 sec., with a mean over-all rate of 116 words per minute.

Comparison of the emotions in this table shows that fear and indifference are most rapid and approximately equal in rate, followed closely by anger, and then by grief and contempt in that order. This ranking remains consistent for all three types of computation. That

TABLE II
MEAN PERCENTAGES OF PAUSE AND PHONATION

	CON- TEMPT	ANGER	FEAR	GRIEF	INDIF- ERENCE
Pause					
Within Phrases	13	14	12	18	12
Between Phrases	20	18	19	29	17
Total	33	32	31	47	29
Phonation	67	68	69	53	71

rate probably is one vocal symbol of emotional expression is indicated by the magnitude of the differences shown. The mean duration of the total speaking time in contempt, for example, is nearly twice that in indifference. When the values in the last row are compared to available data on the oral reading of factual prose it is seen that the rate is somewhat slower than average in simulated contempt and grief, and somewhat more rapid in anger, fear and indifference. Both *McIntosh's*⁴ mean for a 55-word passage and *Darley's*⁵ median for a 300-word selection were 166 words per minute. Any such comparison must be qualified, however, because of variations in the lengths of the samples. It seems probable that factual readings of the 27-word passage used in the present experiment would prove in calculation to be slightly more rapid, on the average, than similar readings of longer selections.

Proportions of the Total Speaking Time Devoted to Phonation

⁴ McIntosh, C. W., Jr. "A Study of the Relationship Between Pitch Level and Pitch Variability in the Voices of Superior Speakers," Ph.D. Dissertation, State University of Iowa, 1939.

⁵ Darley, F. L., "A Normative Study of Oral Reading Rate," M.A. Thesis, State University of Iowa, 1940.

and Pause. That the division of the total speaking time into phonation and pause is a distinctive feature of at least two emotions, grief and contempt, is shown by the values given in Table II. In indifference it will be observed that, of the total duration, 12 per cent was devoted to pauses within phrases⁶ and 17 per cent to pauses between phrases, a total pause percentage of 29. The balance, 71 per cent, is, of course, the proportion devoted to phonation. Approximately these same percentages prevail in all the emotions except grief and this has also been the common finding in previous studies of oral reading of factual prose. In the simulations of grief, however, the ratio of pause to phonation was found to be 47 to 53, instead of approximately 30

TABLE III
NUMBER AND DURATION OF PHONATIONS AND PAUSES. DURATION IN SECONDS

	CON- TEMPT	ANGER	FEAR	GRIEF	INDIF- FERENCE
Phonations					
Mean Number.....	16.0	14.8	14.8	16.7	14.7
Mean Duration.....	.59	.40	.38	.40	.38
Median Duration.....	.45	.33	.30	.35	.31
Pauses Within Phrases					
Mean Number.....	12.2	11.3	11.2	12.8	11.3
Mean Duration.....	.16	.10	.09	.19	.09
Median Duration.....	.15	.10	.10	.14	.09
Pauses Between Phrases					
Mean Number.....	2.8	2.5	2.7	2.8	2.3
Mean Duration.....	.97	.64	.60	1.31	.62

to 70. This increase in the relative amount of pause time in grief is seen from the table to occur both within and between phrases, although it is most marked at the latter points. The striking fact may be noted in passing that in three of the six individual simulations of grief more than 50 per cent of the total speaking time was devoted to silence. Apparently the pause time is a highly important aspect of the slowness of rate in grief. This is not true of contempt, however. Although, as was seen in Table I, the mean over-all rate is even slower in this emotion than in grief, Table II reveals that the proportions of pause and phonation are very similar to those found for anger, fear and indifference.

Duration of Phonations and Pauses. Table III compares the emotions with respect to these aspects of duration. Both the mean and median duration of phonations and of pauses within phrases were

⁶For purposes of analysis, the *phrase* was defined somewhat arbitrarily in this study. Since almost all of the subjects divided the passage clearly into four divisions with pauses after "answer," "times," and "same," these limits were used in all cases.

computed, because several of the distributions were somewhat skewed. Although for any given emotion these two measures may differ in magnitude, either is seen to be satisfactory for comparative purposes.

In duration of phonations, anger, fear, grief and indifference are grouped closely, while the values for contempt are considerably greater. With respect to the duration of pauses, within and between phrases, however, both contempt and grief exceed the other emotions. This is especially striking in the case of pauses between phrases, where the mean duration of such pauses in grief is more than twice that in anger, fear and indifference. Both contempt and grief exceed the other emotions in number of phonations and pauses. These findings are notable when considered in connection with other data discussed above. In comparison to the other emotions both contempt

TABLE IV
MEAN DURATION OF INFLECTIONS IN SECONDS

	CON- TEMPT	ANGER	FEAR	GRIEF	INDIF- FERENCE
All Inflections.....	.18	.13	.14	.14	.15
Downward Inflections.....	.20	.14	.15	.16	.15
Upward Inflections.....	.16	.11	.12	.12	.15

and grief are relatively slow in over-all rate, but it seems clear that this slowness is accomplished in two different ways. In contempt a relatively uniform slowing of the rate is found; phonations and pauses *both* are prolonged, increased in number, and the proportionate division of the total speaking time into pause and phonation is not disturbed. But in simulations of grief the slowness appears to be primarily a function of increased pause length, particularly between phrases, *without prolongation of phonations*, although both increase in number; the total time thus divides more equally into pause and phonation.⁷

Duration of Inflections. An *inflection* is a pitch modulation in a given direction without interruption of phonation. Table IV, which presents the mean durations of inflections, is included primarily to show one additional characteristic of simulated contempt. In general, the situation here is very similar to that of the mean duration of phonations: contempt exceeds the other emotions, which, in turn, are closely grouped. The one exception to this observation occurs in

⁷ In any given sample of speech the number of pauses is, by definition, equal to one less than the number of phonations. That this apparently is not exactly true for the means in Table III is caused by rounding to one decimal place in computing.

the upward inflections of indifference. It is also noteworthy that indifference is the only emotion in which the mean duration of upward inflections is not substantially shorter than that of downward inflections. These upward inflections may be an important feature of indifference; it is recalled that in the study of the pitch characteristics of the same simulations⁸ it was found that the mean *extent* of upward inflections was smaller than that of downward inflections in all emotions, but that this difference was very minor in the case of indifference.

III. SUMMARY

Six male actors simulated five different emotional states vocally, using the same prose passage in all simulations. The readings were recorded phonographically and, by means of a rigid identification technique, were shown to be typical of the intended emotions. Objective measurements of the duration aspects of the simulations were made by means of sound-wave photography; the following were the major results.

1. Considering the data as a whole, anger, fear and indifference were found to differ markedly from contempt and grief. All three of the first group presented rapid rate and short duration of phonations and pauses, but they did not differ importantly from each other in any respect considered in the present study.

2. Contempt and grief, on the other hand, may be differentiated, both from each other and from the other emotions. Although they are similar in that slow rate is characteristic of both, contempt being the slower of the two, the slowness of the latter is produced by approximately equal prolongation of both phonations and pauses, the ratio of pause time to phonation time remaining the same as in factual reading and the more rapid emotions. The slow rate of grief, however, is caused almost entirely by prolongation of pauses, particularly between phrases; so marked is this effect that the total pause time is almost equal to the total phonation time.

⁸ Fairbanks, G. and Pronovost, W., *op. cit.*, 97.

THE STUDY OF RESPIRATORY MOVEMENTS BY ROENTGEN KYMOGRAPHY

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PRIOR to the development of the X-ray, studies of breathing movements in man have depended to a large extent upon some form of pneumograph by which changes in the circumference of the thorax and abdomen are recorded. Needless to say the data thus gathered have been of great value and have provided the basis for important deductions regarding muscular and nerve function in breathing. It is evident to anyone familiar with the construction of the pneumograph, however, that the pneumograph has certain unavoidable limitations in that the records thus secured indicate directly only an increase and decrease in the circumference of the abdomen and thorax attending inhalation and exhalation. The movements of the muscles and bones which cause changes in thoracic circumference and which therefore are of prime importance for their interpretation can be only inferred from the pneumographic record. Movements of the diaphragm also can be only roughly estimated by this means. The pneumograph does not record movements of the diaphragm as such but traces the indirect reflections of these movements as they affect the abdominal wall through displacement of the viscera, or as the diaphragm is in turn influenced by contraction of the abdominal muscles.

A step forward in the study of the mechanics of breathing was made possible by the development of the X-ray. By the use of the X-ray the movement of bodily organs may be observed by the shadows which they cast upon a fluorescent screen or upon a sensitized film. Both means of observation have been employed for the study of the mechanics of respiration and each method has been found to have its own peculiar advantages and limitations. The fluoroscope enables the investigator to observe the nature and extent of movement of the organs of breathing, but provides no measurable record for a careful analysis of the extent or timing of these movements. It is extremely difficult for the observer to maintain a 'frame of reference' for a satisfactory comparison of the changes in position which take place in the thorax. The static roentgenogram provides a measurable record of the position of the various organs of the thorax at any phase of the respiratory cycle but obviously records this position only for a given moment. It may hence be adequate as a measure

of extent of movements but provides no measurable data on the timing or character of such movements. The roentgen kymograph, a comparatively recent development, combines certain features of each of these methods and provides a means whereby a measurable record of the movement of bodily organs may be obtained for scientific study. It is the purpose of this paper to present an evaluation of this instru-

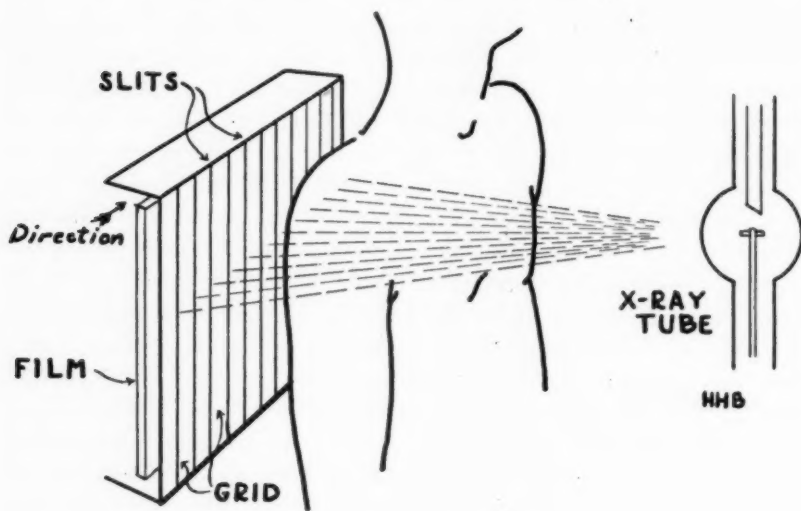


FIGURE 1

Schematic drawing of roentgen kymograph and subject. Grid shown in vertical position for recording movements of ribs and diaphragm. Dashes suggest angle at which X-rays spread from the target causing distortion in shadows cast by organs of the body. For simplification the rays are shown only in the horizontal plane.

ment as a means of gathering data on the mechanics of breathing with reference to various aspects of speech.

The principle of the roentgen kymograph was first employed as early as 1911 by the Polish physiologist Sabat, but it was not until 1932 that the technique was brought to a high degree of perfection by Pleikart Stumpf.¹ The instrument is illustrated in Figure 1.

The essential part of the roentgen kymograph is a grid set in a moving frame. The grid of the machine which we used consists of a thin sheet of lead having slits, .4 mm. wide and 12.4 mm. apart. The

¹For full details see Stumpf et al., *Roentgenkymographische Bewegungslehre Innerer Organe*, (1936); some details in Scott and Moore, *Construction of Roentgen Kymographs and Kymoscopes*, (1936).

roentgen rays, after traversing the subject, pass through the slits to the photographic film. The grid may be so inserted in its framework that the slits run either parallel, perpendicular or at any other angle, to the axis of the body. The slits may be either straight or curved. In operating the kymograph either (1) the film may be moved at a uniform speed past the slits of the grid or (2) the grid may be moved across the film. The distance moved is a fraction of a millimeter less than the distance between two adjacent slits, thus leaving narrow, parallel lines of unexposed film .4 mm. wide and separated by a distance of 12 mm. The broad strips between the lines are the exposed portions of the film. The result is a photograph of the type shown in Figure 2² taken with a stationary grid and a moving film. The machine used for the present investigation was manufactured by the Leibel-Flarsheim Company. The slits are straight and directed parallel to the vertical axis of the body. The film moved from left to right. The films and equipment were made available at Harper Hospital, Detroit, through the kindness of Dr. William A. Evans, Jr.

As in the static roentgenogram the intensity of the shadows indicates the relative density of the tissues through which the X-rays pass. The relatively opaque tissues (for example, bone) intercept a larger amount of the rays, and hence the emulsion of the film is subjected to less change. The shadow of the ribs is therefore light in comparison to that cast by the more transparent tissues of the interspaces. The regions representing the heart, diaphragm and mediastinal structures are similarly light in shade. The density of the shadows is further affected by the mass of the tissues, so that other factors being equal, the larger the mass the lighter the shadow.

At the bottom of Figure 2 are seen triangular white areas which represent sections of the moving diaphragm. The larger, light oval area above the diaphragm on the left represents the heart. The heart beat is usually clearly recorded in the serrated pattern of the heart shadow. The long, light vertical area in the mid-thorax represents the spinal column, the mediastinal structures and the sternum. Portions of the clavicles are also visible above. The downward curving pattern of roughly lozenge-shaped light areas (increasing in vertical diameter toward the periphery) at the right and left of the center represent the posterior halves of the ribs (the anterior portions are faintly visible in some films). If the vertical dimension of the subject's chest does not exceed 14 inches, the entire thoracic cage from the first to the twelfth rib can be clearly visualized.

² All illustrations of roentgen kymograms in this paper are reduced to about one-third the size of the original films.

The roentgen kymogram does not represent the movement of any organ as a whole but shows the amplitude and speed of movement of as many small sections of it as there are slits lying between the organ and the film. For example, the edges of the light triangular areas between each two perpendicular lines represent a moving point or points on the surface of the diaphragm. If a moving point on the edge of the diaphragm lies continuously in the same plane as the slits (which is approximately the case near the peak of the dome) the edges of the triangular areas represent the vertical movement of the single point continuously in the line of the slit during the period of exposure (6 seconds). Each upper peak would accordingly represent the position of the given point at maximum expiration, each lower point would represent its position at the moment of maximum inspiration.

Since the film moves from left to right of the observer as he faces the roentgen kymograph, points at the right edge of each area exposed are the first ones exposed, and those at the left are the last. The film therefore is to be read from right to left. Since the film moved 12 mm. during the six-second exposure, each second is represented by a distance of 2 mm. measured horizontally from right to left on the kymogram. Therefore the peaks represent the diaphragm at the end of expiration and the bottom point at the left of each peak represents the end of the succeeding inspiration. All points equidistant from the vertical lines are therefore simultaneous. In the main we regard the time values of these films as accurate to a high degree; estimations of amplitude are subject to more interpretational factors.

The same principle applies to the movement of the ribs, the curving upper and lower edges of the lozenge-shaped areas representing the movement of points on the upper and lower edges of the ribs. Note that owing to the peculiar shapes and positions of the ribs, each rib and also each region of each rib has a different amplitude and hence different speed of movement. In general the movement of the rib increases in amplitude as the distance from its articulation with the spine is increased toward the periphery. Apparent exceptions to this are probably due to the peculiar rotational movement of the rib which results in a change in the width of costal area casting the shadow.

Figure 3 illustrates the spatial and temporal relationships between the movements of the ribs and the diaphragm. When the diaphragm and ribs are moving in exactly opposite phase (which is believed to be usually the case) point *a* on the diaphragm is exposed simultaneously with point *a'* on the rib, and since the film is moving from left

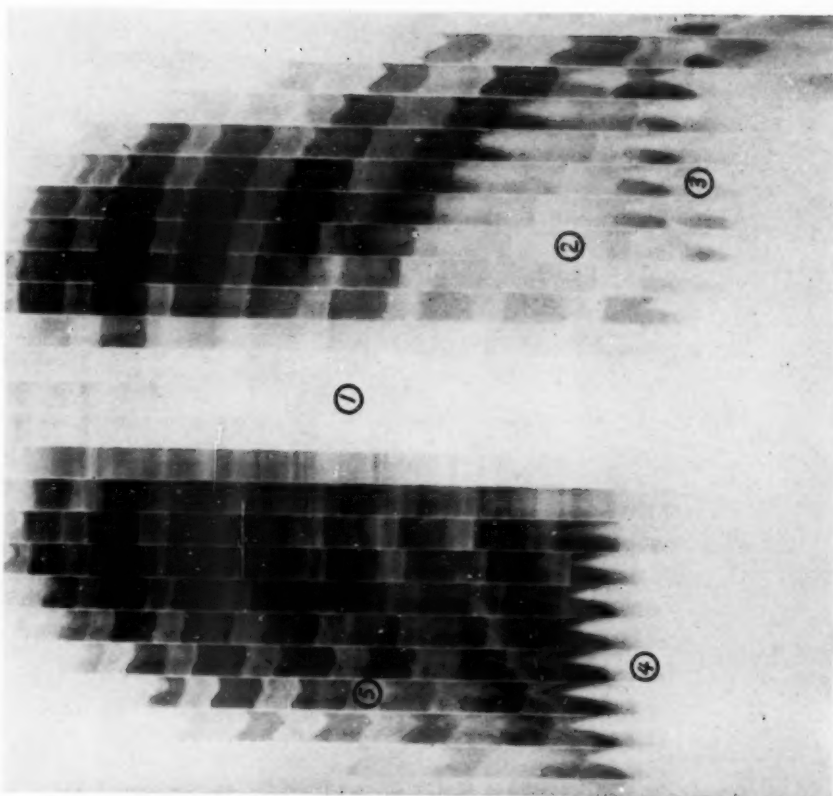


FIGURE 2
Roentgen kymogram showing an anteroposterior view of the chest and diaphragm during quiet vegetative breathing. Read from right to left. The numbered areas indicate: (1) mediastinum, (2) heart, (3) left hemi-diaphragm, (4) right hemi-diaphragm, (5) right 7th rib.

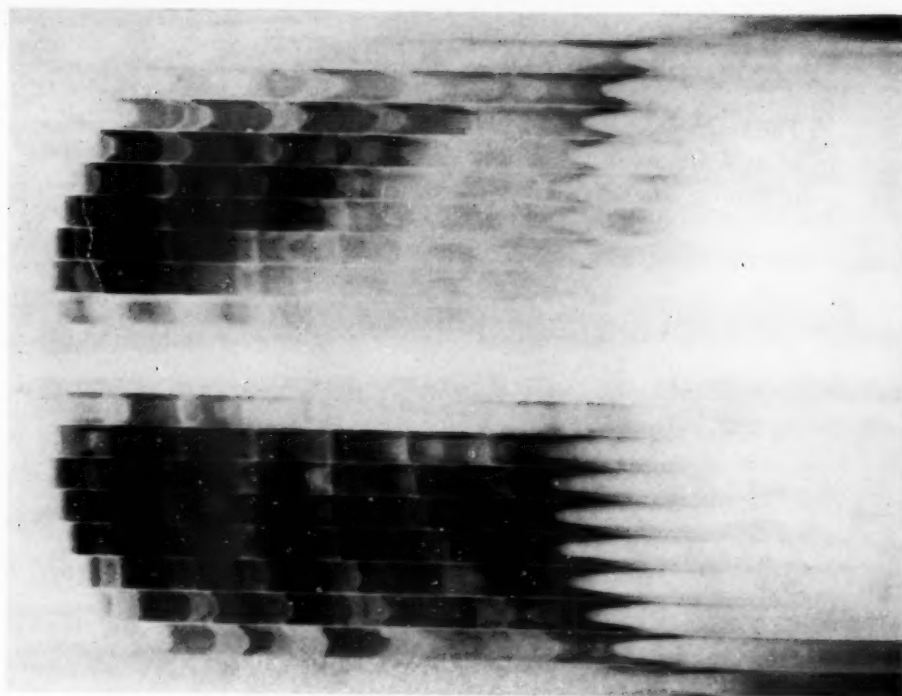


FIGURE 5
Normal subject during vegetative breathing.

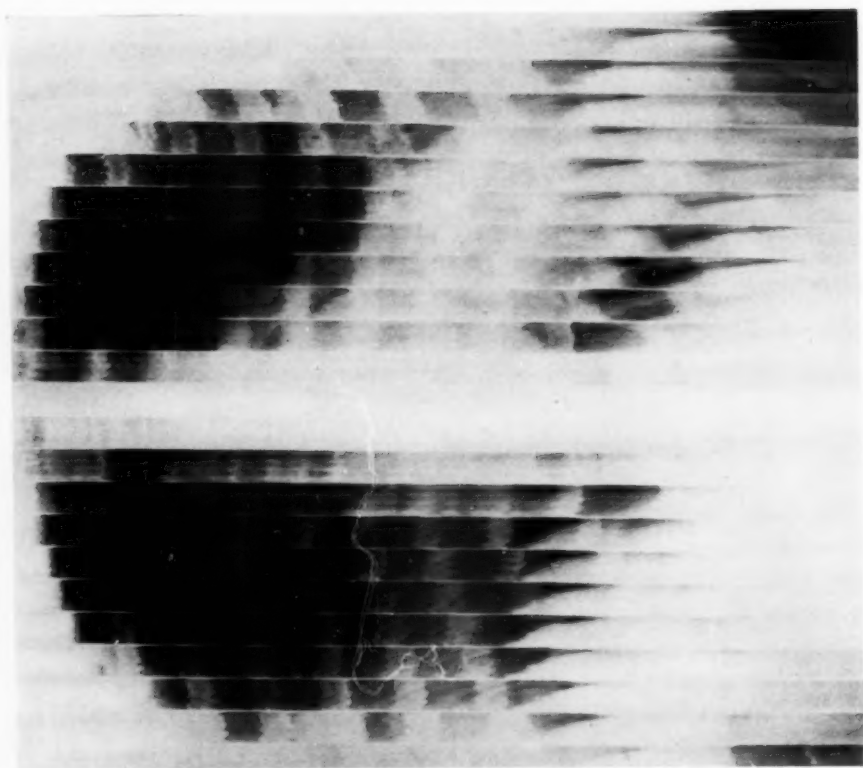


FIGURE 6
Normal subject during speech.

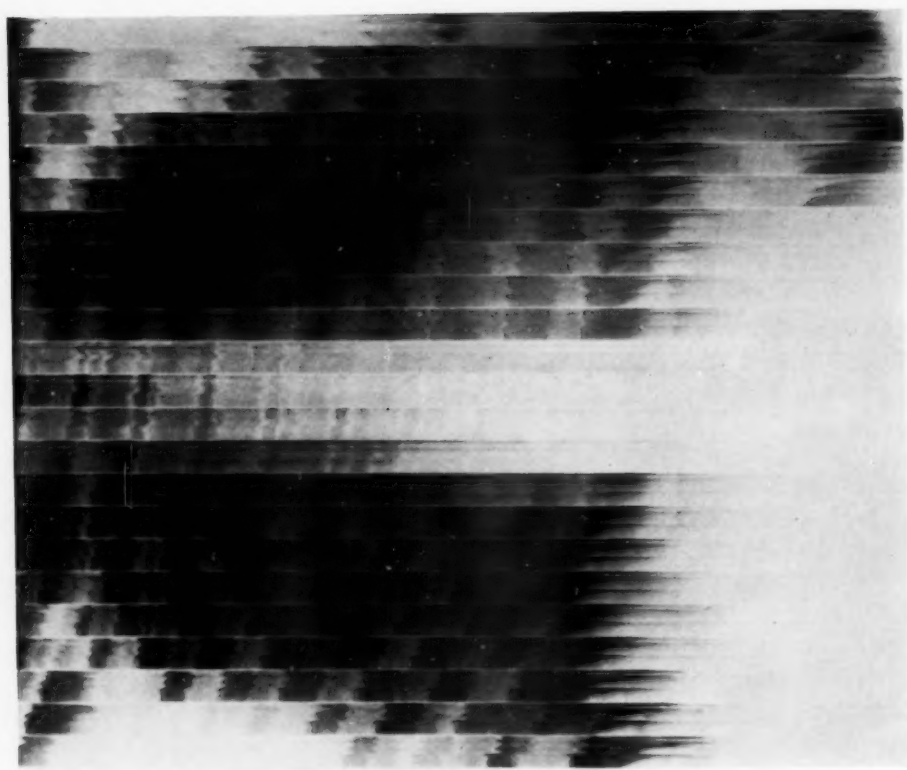


FIGURE 7
Stuttering subject during stuttering speech. Note vertical displacement of vertebral bodies.

to right, the lines ab and $a'b'$ are laid down during the exposure in the direction a to b and a' to b' . Thus each downward movement of the rib corresponds to an upward movement of the diaphragm, and the peaks of the diaphragm line are simultaneous with the bottom points of the rib record.

In so far as the details of the shadows of the ribs and diaphragm are concerned, they are usually defined with sufficient sharpness to permit accurate measurement (within $\frac{1}{2}$ mm.) of the extent, form and speed of their movement. The investigator who uses this technique must be prepared to make certain judgments, however, and to allow for some inadequacies in the films. We wish to call attention to several of these factors and to indicate our practice in dealing with them.

It should be pointed out that although usually the definition of shadows is adequate for measurement, the investigator may occasionally discover that some portion of an organ is more precisely defined than another. For instance, the lower border of a rib can sometimes be measured with much greater accuracy than the upper. Sometimes the shadow of the diaphragm at the end of the inspiratory cycle shows a gradual modification in shading, so that it is difficult for the inexperienced person to judge the extent of displacement which has taken place. With practice, however, it is possible for the investigator to form consistent judgments regarding these matters.

The variability in definition of the shadows may be ascribed to several causes. For one thing the shadow does not in actuality represent the movement of a single point on the surface of the rib or diaphragm, but usually is cast by a succession of points. In interpret-

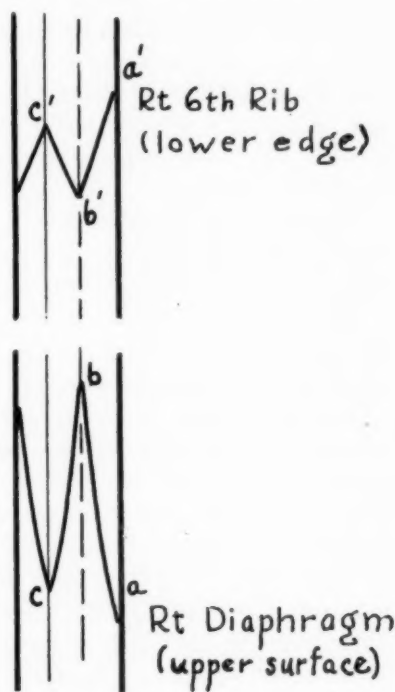


FIGURE 3

Schematic drawing showing tracing of inferior border of the right 6th rib and the upper surface of the right hemi-diaphragm. Dashes indicate position at full expiration; continuous line full inspiration.

ing the shadows of the diaphragm, for instance, one should keep in mind that the lateral portions of the domes do not move in a vertical plane but move obliquely upward and medially during expiration and downward and laterally during inspiration. Successive points on its surface will therefore come into line with the slits as the domes rise and fall, and the shadow cast will be from an obliquely moving series of points. A similar condition probably exists for the interpretation of the medial portions of the diaphragm even though their direction of displacement is more nearly in the vertical plane, for in this case the complexity of movement is associated with the downward-forward movement of the domes, so that in all probability the shadows of the medial portions show a succession of points moving anteriorly. In short, one should remember in dealing with these data that the movement of the diaphragm is not that of a piston rising and falling in a cylinder but is really a complex one of downward-forward displacement accompanied by an extension of the perimeter in all directions.

Theoretically certain other allowances should be made in the measurement of the films. If, for example, in the case of the stationary grid and moving film, a tissue is moving in such a way that it remains continually in the plane of the rays passing through a slit, and moves in the same direction as the rays (from target to film), the shadow on the film will show no displacement. If the points of the diaphragm, ribs, etc., recorded in the film moved exactly parallel with the slits, and in a plane parallel with the plane of the grid, the extent of their excursion would equal the perpendicular distance between the top and the bottom points corresponding to the extremes of inspiration and expiration, only if the rays were parallel with each other. However, since the roentgen rays spread in the form of a cone from their source,³ and therefore are farther apart when they strike the film, than when they are passing through the body, the measurements of distance on the film slightly exceed the corresponding movements of the tissue themselves (see Fig. 1).

If the motion of the points photographed lies in the plane of the film and at any angle other than parallel to the line of the slits, the following trigonometrical calculations are necessary to determine the exact distance it moves. It is assumed that the film is parallel with the frontal plane of the body and is moving toward the observer's right at right angles to the slit, and with a speed of 2 mm. per second. Let line EF (Fig. 4) represent a vertical line parallel with the slits;

³ As illustrated in Fig. 1. The distance from the target to the cassette was in this case 28 inches.

let YO represent the position of a rib (made straight for simplification) at the moment of beginning of inspiration and YD the same at the moment of completed inspiration. O represents a point (on the edge of the rib) which is located in the line of the slit and is therefore being photographed at the moment of beginning of inspiration. As the rib moves along an arc in the direction OD, a succession of points on the edge of the rib come opposite the slit, each successive point being nearer Y than its predecessor. At the completion of the inspiratory act, the point A on the same edge of the rib will be opposite the slit, and will be photographed. If the inspiratory act occupies 2 seconds, the film will have moved 4 mm. to the right. The line AO will then represent the vertical displacement of the shadow of the rib.

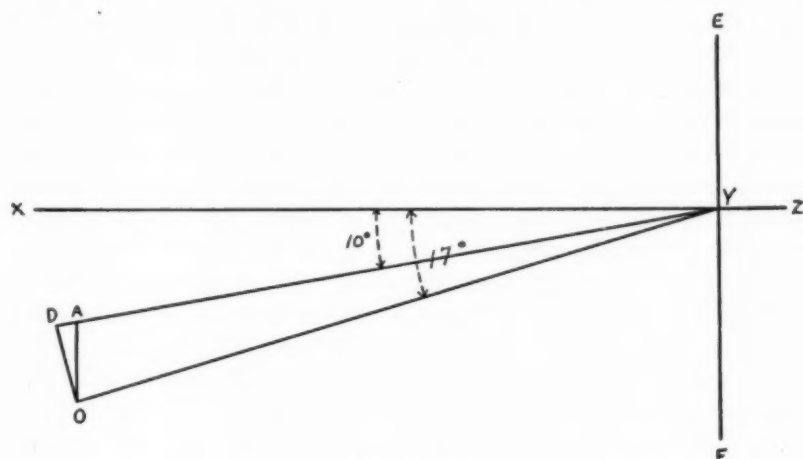


FIGURE 4

Diagram showing method of calculating correction for distortion.
Illustration is reduced from original drawing by one-fourth.

The distance OA is measurable on the film. The angle OAD is 90° and the angle DOA may be taken as mean of XYD and XYO. We can now obtain the length of OD,⁴ that is, the displacement of the rib during the inspiratory act by the formula

$$OD = OA \sin DAO$$

The following example illustrates this method. In the film of subject B taken during quiet breathing, Y (Fig. 4) represents the

⁴OD is really an arc of 7° along a circle of 12 cm. radius. Since the difference in the length of this arc and its cord is only a small fraction of a mm., we may treat it as a cord or an arc without seriously affecting the computation.

point of articulation of the 4th rib; YO and YD represent the positions of the rib at the beginning and the end respectively of the inspiratory act. AO represents the vertical displacement of the shadow of the rib during the inspiratory movement. This is measurable on the film and is 15 mm. The angle passed over by the rib during the inspiratory act may be taken as one-half of the sum of the angles YZD and YZO, i.e., $13^{\circ}30'$. Then

$$OA : OD :: 90^{\circ} : 75^{\circ}30'$$

$$:: 1 : .9724$$

$$\text{Therefore } OD = 15 \text{ mm.} \times .9724 = 14.48 \text{ mm.}$$

The actual movement of point O on the rib is, therefore, .52 mm. less than the vertical displacement of the shadow of the rib on the film. For absolute determinations of costal movement this correction must be made. This small difference may be disregarded, however, for comparative measurements of points which are approximately equi-distant from the locus of costo-vertebral articulation. It should be noted that the above figures were determined from points twelve centimeters from the point of articulation. Obviously, the difference would be greater for points on a longer radius (that is, farther toward the periphery of the chest).

The amplitude of the expiratory act can be obtained by the same method. Since the rib is not moving in a plane absolutely parallel with that of the film, but is either approaching or receding from it, the distance OD will differ slightly from the vertical displacement of the rib. This correction could be made from another film simultaneously taken laterally at the angle 90° with the plane of the first photograph.

Difference in speed of the expiratory and inspiratory movements may also be taken into account inasmuch as this factor will influence the density of the film. In most cases, these more complicated factors may be disregarded, the measurement of the shadow being adequate to practical purposes.

A glance at the films reproduced in this article is sufficient to show that all sections of the costal and diaphragmatic shadows are not equal in extent of displacement or in sharpness of definition. In choosing sections for measurement the investigator must make his own judgment in terms of the kind of data he wished to secure. For measurements of costal displacement we prefer to depend upon sections near the lateral borders of the lung fields.

In making determinations of the extent of costal movement one may make measurements parallel to the slits (with corrections as indicated above), or he may make use of a limb protractor for cal-

ulation of the angle formed by rotation of the rib around its points of articulation with the vertebral bodies. We believe the latter method to be accurate since one can thus allow somewhat for the positional changes of the spinal column during breathing. Reference to Figure 7 will illustrate this point. Note that the shadows of the vertebral bodies show a pattern of movement similar to that of the ribs, and that the amplitude of the displacement demonstrated is an appreciable one. Calculation of costal displacement by means of vertical measurements would obviously be fallacious in this case unless one could in some way allow for the rise and fall of the entire thoracic cage. The limb protractor permits one to make such allowance by shifting the point of rotation of the limb to coincide with the points on the vertebral shadows that correspond in time to the costal displacements. So far as we know this method has not been used by previous investigators who have commented upon the amplitude of costal movements as measured by roentgen kymograms. It may be that the use of this method will bring different results from those published heretofore.

As a matter of practical consideration we would point out that we prefer to have the subject face the target of the X-ray machine rather than to have him place the anterior chest against the cassette holder. The former position facilitates the investigator in carrying on conversation with the subject for those instances in which breathing records are being made during speech. This position is perhaps not quite so satisfactory from the standpoint of steadying the subject for the avoidance of lateral body movements, but any inadequacies in this regard can be compensated by binding the subject to the cassette holder by a thin gauze band, and by cautioning him not to shift position while the film is being taken.

Figure 5 shows another kymogram made during vegetative breathing. A comparison of Figure 2 and Figure 5 will indicate the highly individual character of breathing habits which may be observed by the roentgen kymograph (compare R. Gesell, 1936).

Figure 6 shows a pattern of speech breathing of a normal speaker. Figure 7 shows a pattern of speech breathing of a stutterer during stuttering speech.

From the foregoing discussion it is apparent that we can determine with a considerable degree of accuracy the extent, speed and duration of the movement of the various organs during breathing. The roentgen kymograph technique, though but recently perfected, has been extensively used for the diagnosis of pathological conditions of the heart, digestive tract, lungs and diaphragm. The mechanics of breathing has been studied very little by this means. Richter (1935) applied

the method as a check on his experiment in changing the type of breathing of twenty soldiers from thoracic to diaphragmatic. He combined the use of the spirometer and the roentgen kymograph, and was thus able to correlate volume changes in the lungs with the movements of the diaphragmatic and thoracic walls. Cignolini (1938) devised certain improvements of method, and in 1936 he and Richeri published a brief statement of their observations on breathing. In 1938 Richeri applied this method to the investigation of the breathing phenomena of stutterers. So far as we have been able to determine, however, this technique has been used for the study of vegetative breathing by only a few scholars (1939), and not at all for the study of the mechanics of normal speech breathing.

The following characteristics of the respiratory movements lend themselves especially to investigations of temporal and spatial relationships by the roentgen kymographic method.⁵

1. Temporal relationships
 - a. Comparison of the movements of the two domes of the diaphragm
 - b. Comparison of the movements of the right and left ribs
 - c. Comparison of the movements of the ribs and diaphragm
2. Spatial relationships
 - a, b, and c as above

The roentgen kymograph can be used successfully for the study of the mechanics of breathing, and provides data not hitherto obtainable. It has certain advantages over the pneumograph, and will probably provide information whereby we may estimate the accuracy of measurements made by the pneumograph. The shadows cast by organs of the thoracic cage can be measured for the extent, speed and form of their movement during breathing. Calculations for error due to mechanical features of the method indicate that the error is small and that these measurements have a high degree of accuracy. One of the main disadvantages of the equipment is that only a relatively short period of time can be used for exposure, and that accordingly only one or two complete cycles of respiration usually can be recorded for measurement. A longer exposure could be secured by reducing the number of slits and thereby widening the sections. A section width of approximately 27 mm. would probably be adequate for our purposes.

The data gathered thus far indicate that some of our concepts of

⁵ These characteristics will be discussed in an article to be published in the near future.

the mechanics of breathing may be changed or at least clarified by the use of the roentgen kymograph.

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SOME RESULTANT CHANGES AFTER FILLING (HIGH) PALATAL VAULT

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INTRODUCTION: Palatography (the study of tongue-palate contacts)¹ has a direct bearing upon the problems of two fields: namely, speech improvement and dentistry. The dental or oral surgeon who understands the relation of his work to the function of speech is more successful in obtaining satisfactory results after operation and treatment. One of the problems involved is that of the high-arched palatal vault.

The object of this study is to determine the significance in normal speech of a high-arched palate as compared with a normal broad palate. A high-arched palate was reduced to a normal broad form and palatograms and recordings of various phonetic sounds were made to show possibilities for treatment of defective speech, and for corrective modification of full dentures. From this beginning an attempt was made to determine the possible pleasantness or unpleasantness of the effect of these dentures upon speech.

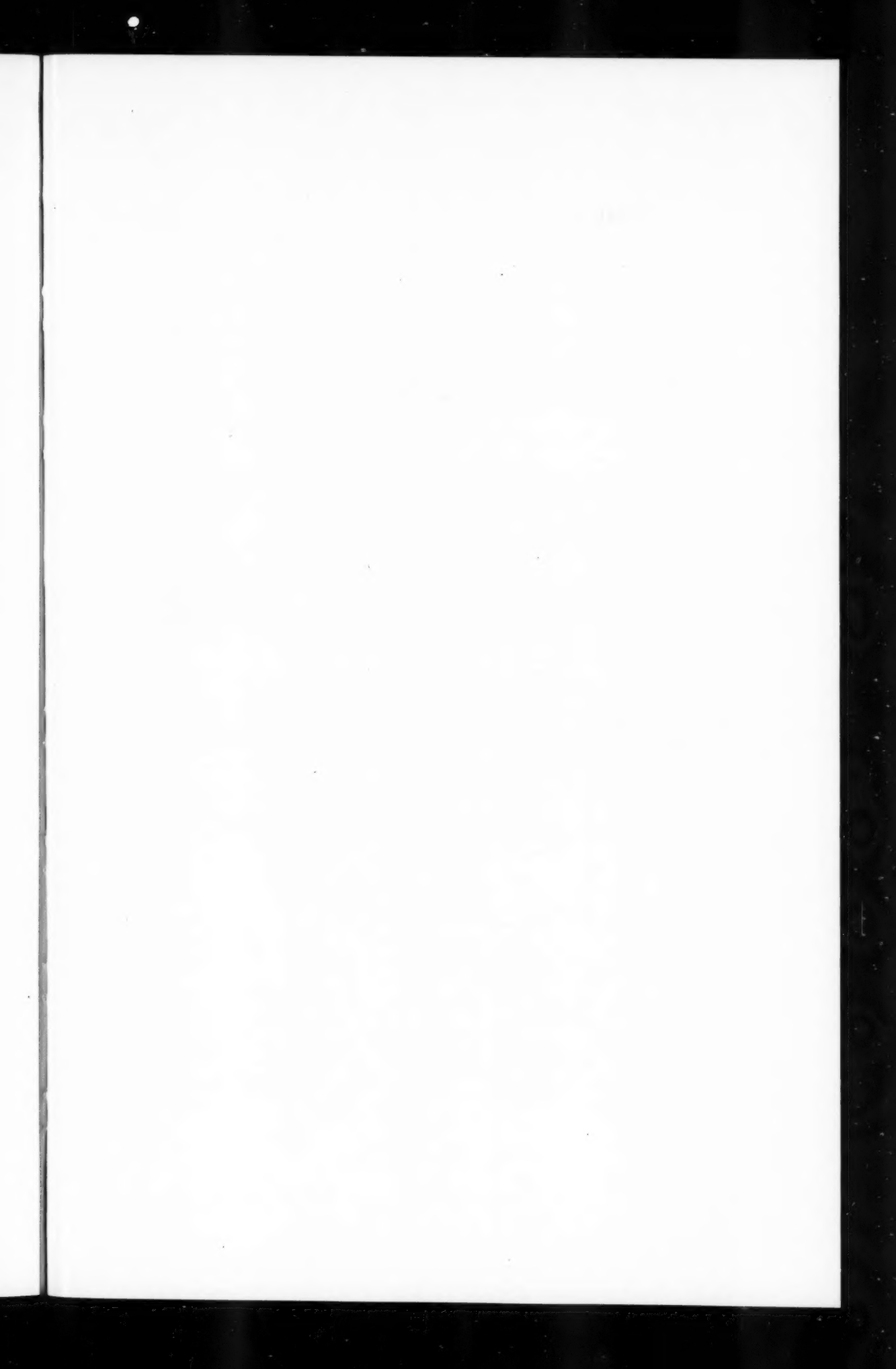
PROCEDURE

Technique: In the following technique economy of time and adaptability with comfort to the subject were the controlling factors.²

The impression of the palate of the subject was made with Kerr's Impression Compound. The ratio was two sheets of white compound well incorporated with one sheet of black. (This combination has proved to be the most desirable in taking impressions of a full denture or partial complement of teeth in the Orthodontic department of the Ohio State Dental College.) The dragging of the compound from between the interproximal spaces and undercuts is reduced somewhat by this combination but is still enough to impair the value of the impressions for the making of pseudo-palates for palatograms. The control palate impression was made with *Dentocol* and proved to be ideal because of the minimum distortion of the undercuts. *Coecal*,

¹ Moses, E. R., Jr., "Palatography and Speech Improvement," *The Journal of Speech Disorders*, 14, (June 1939), 103.

² The following technique was developed by Karl Becker, D.D.S., a junior in the College of Dentistry at the time of this experiment and at present an interne in the College of Dentistry, Ohio State University. The technique was evolved by Dr. Becker as a part of a Speech 700 research course under the supervision of the author.



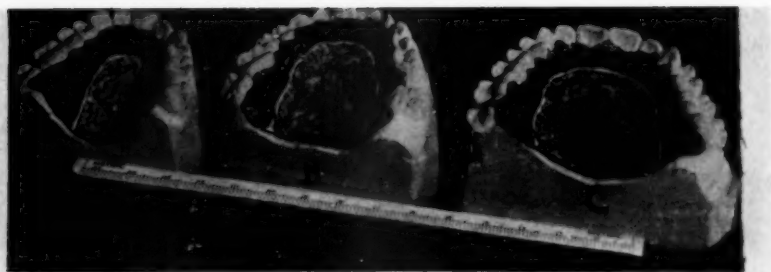


FIGURE 1



FIGURE 2



FIGURE 3

FIGURE 1

Cast A—Experimental subject

Cast B—Experimental subject

Cast C—Control subject

These casts are shown with the palatal plugs.

FIGURE 2

Shows dimensions of palates in centimeters.

FIGURE 3

Shows median sections of palates with their respective palatal plugs.

because of its durability and hardness, was used to pour the models. The terminations of the hard palates were marked off on the casts by examining the mouth with the aid of landmarks.

The pseudo-palates were made from ordinary pink base-plate wax, approximately 16 gauge, reinforced with ordinary surgical gauze. One sheet of wax was thoroughly softened by holding it high above a gas flame and then placed on a piece of wax paper covered with a thin film of soap, vaseline, or oil. One thickness of gauze was laid over the wax and rolled into the wax by heavy pressure with a rolling pin, at the same time reducing the thickness of the wax as much as possible. The original piece of wax and another piece were thoroughly softened and laid together with the gauze between and the second piece of wax on top. The united wax can be softened several times more and rolled to reduce the total thickness to less than 20 or 24 gauge, as desired. Much time could be saved by starting with the pink wax approximately 26 gauge. It might make a stronger mass if the gauze were first soaked in molten wax and heated to allow all excess wax to run off before it is rolled into sheets of wax.

The reinforced wax was then softened, adapted to the model, and trimmed until the pseudo-palate was formed, extending into the undercuts of the necks and interproximals of the teeth for additional retention. A razor blade is ideal to trim with, or a small scissors if the wax is warm enough not to be brittle. It may then be necessary to scrape wax off to make a very thin pseudo-palate. It can be scraped down to the gauze and still be strong enough for all procedure. The end-product need not be thicker than 26 gauge, or 1/32 inch, when the gauze shows through the wax very clearly. This gives a very light and thin pseudo-palate which will stand a surprising amount of abuse, and which easily can be modified and readapted as desired.³

The pseudo-palate was painted with one coat of black India ink (see Figures I and III), and this was followed by a thin coat of shellac, thus providing an excellent background for a very clear palatogram. Unscented talcum was dusted on the dry palate with a cotton puff for making palatogram prints of the tongue contact.

The plugs for filling the vault of the palate were made on the models with the pseudo-palate in place, (see Figure III). The pseudo-palate was dusted with talcum and a sheet of pink base-plate wax was warmed and adapted over the vault of the palate. It was allowed

* It will cause little discomfort to the subject. It also can be slightly softened and re-adapted on the model, or, better still, it simply can be re-inserted into the mouth. The mouth temperature will soften the pseudo-palate so that it can be sucked into place.

to cool and then removed to make certain that it was not sticking to the pseudo-palate. It was replaced and wax was melted onto it to build it up to the desired filling. Before it was thoroughly cooled it was readjusted with the thumb, cooled, removed, and trimmed to a feather edge around the entire periphery and so shaped as to form a normal vault.

Several plugs with varying degrees of filling were made; an excess of filling will cramp the movement of the tongue, and cause marked impediment in the speech. As thick a plug as possible without impaired speech was used in the high vault mouth and the low-vault control mouth. (Slightly warming the pseudo-palate and plug in warm water and placing them together on the model with a slight thumb pressure will hold the plug securely. It can be removed easily when necessary.)

Subjects and Sound Combinations: Three subjects, to be designated as subjects A, B, and C, participated in the preliminary study, each completing a set of palatograms, both with and without the palatal plug, for the following sound combinations:⁴

ku	(coo)	kik	(kick)
uk	(Luke)	aet	(at)
aek	(acme)	tæp	(tap)
kae	(cap)	hit	(hit)
ɑ:k	(October)	tip	(tip)
kɑ:	(calm, cop)	tu	(too)
ɑ:r	(are)	but	(boot)
rɑ:	(rah)	ti	(tea)
æər	(air)	it	(eat)
iər	(ear)	tʃ	(tsh)
rim	(ream)	tub	(tube)

Note: The author has chosen sound combinations which occur in common words.

In the final experiment the following three vowel sounds were used in order better to control the experiment. The initial and final consonants in the latter group remained the same:

ah as in *pop*
ee as in *peep*
oo as in *poop*

In this final experiment three subjects (H, I, and J) whose speech

⁴The following words containing abutting consonants were considered but not used: ear-tab, ear-drum, peak load, Pike's Peak-line.

was general American speech were chosen, and three recordings were made of each subject's speech. A fourth subject (K) was used to check on the other three subjects (see Table VII).

Palatograms and Recording

1. At least two palatograms were made of each sound under the various conditions and with each subject.
2. Two methods of recording were used.

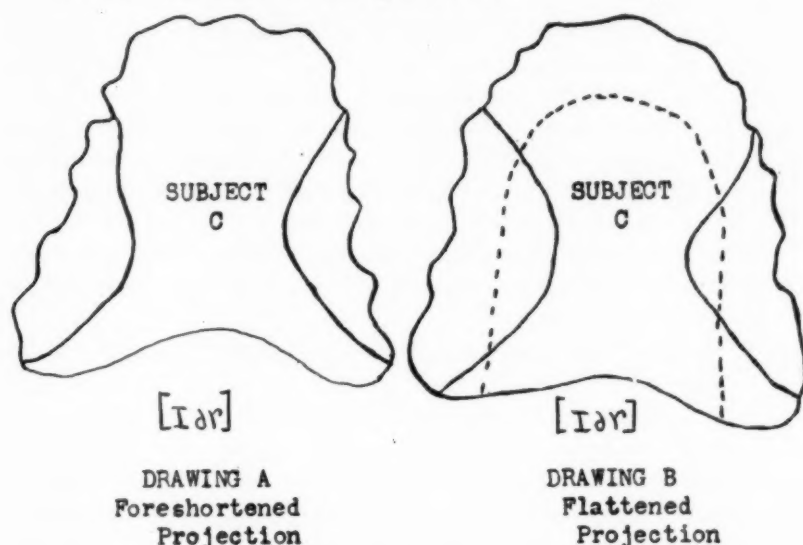


FIGURE 4

In drawing B the area within the broken line represents the palatal plug.

In drawing A there is a palatogram of the sound *ear* [iər] made by Subject C.

In drawing B the same sound [iər] has been recorded with the palatal plug inserted.

TABLE I
GROSS ANALYSIS OF XZ, XY, YZ* RELATIONSHIPS IN SUBJECTS H, I, J

RELATIONSHIP	N	M _{diff}	σ_{dist}	σ_m	C.R.
xz	1716	.552	1.34	.032	17.2
xy	1716	.395	1.07	.026	15.2
yz	1716	.16	1.13	.027	5.9

* xz = relationship of all sounds made without any appliance in the mouth to all sounds made with the palatal arch filled in to a normal broad palate.

xy = relationship of all sounds made without any appliance in the mouth to all sounds made with a pink wax pseudo-palate following the contour of the hard palate.

yz = relationship of all sounds made with pink wax following the contour of the hard palate to all sounds made with the palatal arch filled to a normal broad palate.

- a. The usual foreshortened projection inverting the pseudo-palate on a stiff paper, drawing around it, cutting it out, turning the pattern over and using it to make multiple outlines of the pseudo-palate for outlining the palatogram contact of the tongue. (See Figure IV, drawing A.)
- b. Flattened projection similar to A, but with the pseudo-palate convex side up and rolled over to one side to outline periphery and rolled across paper on a line approximately $\frac{1}{2}$ from the posterior end of the pseudo-palate to outline the opposite side, thus giving a distorted flat surface pattern in the anterior region, but in this case this method gives a fairly accurate surface recording of the vault which is more illustrative on paper than a shadow projection which corresponds to A. (See Figure II for differences in vault measurements. See also Figure IV, drawing B.)
3. With the plug in the pseudo-palate the surface width was measured over the plug and the rolled out pattern shortened in width proportionately.
4. The plug was outlined to show the degree of contact on the plug. (See Figure IV, drawing B, iær.)
5. Recordings were made on both types of palate outlines for each sound.
6. In the final experiment three recordings of each subject's speech were made on aluminum acetate records (of his normal speech, of his speech with the pseudo-palate following the contour of his palate, and of his speech when the high palatal vault had been altered by the pseudo-palate filling to a broad arch).
7. The records of subjects H, I, J were submitted to a group of 66 drama students in a class at the Ohio State University.
8. The records of subject K were submitted to 43 student judges in a public address class of the author at the Ohio State University.

Analysis of Data and Discussion: The data used in the results and conclusions are drawn entirely from the final experiment involving subjects H, I, J, and K.

In determining the degree of pleasantness or unpleasantness the following five-point scale was used:

1. unpleasant
2. fairly unpleasant
3. average (neither unpleasant nor pleasant)
4. fairly pleasant
5. pleasant

In analyzing the pleasantness and unpleasantness of the sounds the author considered such factors as:

1. the significance of the difference between trials, x , y , z ; that is x (trial with no appliance in the mouth), y (trial with a base-plate

TABLE II
STATISTIC t FOR SUBJECTS H, I, J
Sounds ah , ee , oo
SOUND ah

SUBJECT H

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C	t	P†
			x	y			
xy1	1	66	231	207	24	2.9	<.01††
xy4	2	66	108	121	-13	-1.7	-.10††
xy7	3	66	183	180	3	.43	.70
yz1	1	66	y207	z208	-1	-.12	-.90
yz4	2	66	221	203	18	2.4	.02†
yz7	3	66	180	188	-8	-7.5	<.01††
xz1	1	66	x231	z208	23	2.5	.02†
xz4	2	66	208	203	5	.61	.50
xz7	3	66	183	188	-5	-.55	-.60

† Lindquist, p. 53, Table 3.

†† Figured to the nearest 10% when above the 5% level.

SOUND ee

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C	t	P
			x	y			
xy2	1	66	191	177	14	1.84	.10
xy5	2	66	184	153	31	2.8	<.01††
xy8	3	66	188	190	-2	-.3	-.80
yz2	1	66	y177	z191	-14	-1.5	-.10
yz5	2	66	153	176	-23	-3.0	<.01††
yz8	3	66	190	162	28	2.7	.02†
xz2	1	66	x193	z192	1	.07	.90
xz5	2	66	184	176	8	.63	.60
xz8	3	66	188	162	26	-2.42	-.05†

SOUND oo

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C	t	P
			x	y			
xy3	1	66	216	223	-7	-1.0	-.30
xy6	2	66	193	162	31	3.6	<.01††
xy9	3	66	No	Data		Available†	
yz3	1	66	y223	z202	21	2.9	<.01††
yz6	2	66	162	178	-16	-2.1	<.05†
yz9	3	66	No	Data		Available†	
xz3	1	66	x216	z202	14	1.4	.20
xz6	2	66	93	78	15	1.4	.20
xz9	3	66	No	Data		Available†	

† Recordings were defective; so records were discarded.

wax pseudo-palate following the contour of the hard palate), and *z* (trial with a base-plate wax pseudo-palate plus the palatal filling to make a normal broad palate).

2. the significance of the difference between stimuli *ah*, *ee*, *oo*.

3. the significance of the difference between sexes, both in judging pleasantness and unpleasantness, and in adaptation of speech to the palatal filling.

SUBJECT I

SOUND *ah*

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C	<i>t</i>	P
			x	y			
xy1	1	66	244	205	39	5.6	<.01**
xy4	2	66	174	159	15	2.0	.05*
xy7	3	66	197	177	20	3.2	<.01**
yz1	1	66	y204	z187	17	2.36	.05*
yz4	2	66	161	177	-16	-2.0	-.05*
yz7	3	66	177	170	7	.79	.50
xz1	1	66	x243	z187	56	5.0	<.01**
xz4	2	66	174	177	-3	-3.2	<.01**
xz7	3	66	197	170	27	3.7	<.01**

SOUND *ee*

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C	<i>t</i>	P
			x	y			
xy2	1	66	231	217	14	2.1	.05*
xy5	2	66	189	167	22	2.2	.05*
xy8	3	66	217	207	10	1.5	.20
yz2	1	66	y217	z166	101	17.0	<.01**
yz5	2	66	167	158	9	1.4	.20
yz8	3	66	198	157	41	4.4	<.01**
xz2	1	66	x231	z116	115	14.5	<.01**
xz5	2	66	189	161	28	2.87	<.01**
xz8	3	66	207	157	50	5.1	<.01**

SOUND *oo*

ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E-C		P
			x	y			
xy3	1	66	211	199	12	2.5	.02*
xy6	2	66	205	194	11	1.0	.30
xy9	3	66	225	203	22	3.0	<.01**
yz3	1	66	y199	z182	17	2.0	.05*
yz6	2	66	194	179	15	1.92	.10
yz9	3	66	203	199	4	.4	.70
xz3	1	66	x211	z182	29	3.14	<.01**
xz6	2	66	206	180	26	2.44	.05*
xz9	3	66	225	199	26	3.0	<.01**

4. the significance of the difference between subjects H, I, J, K.

5. controls

a. hearing

b. emotional adjustment

Statistic *t* was used to determine the significance of the relationship between the various judgments of pleasantness and unpleasant-

SOUND <i>ah</i>						SUBJECT J	
ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E - C	<i>t</i>	P
xy1	1	66	x 261	y 239	22	3.67	<.01**
xy4	2	66	245	202	43	5.42	<.01**
xy7	3	66	221	202	19	2.16	.05*
yz1	1	66	y239	z213	26	3.61	<.01**
yz4	2	66	202	224	-22	-3.2	<.01**
yz7	3	66	202	187	15	1.3	.20
xz1	1	66	x261	z213	48	5.25	.01**
xz4	2	66	245	224	21	2.08	.05*
xz7	3	66	220	184	34	3.71	<.01**

SOUND <i>ee</i>							
ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E - C	<i>t</i>	P
xy2	1	66	x 247	y 185	62	7.23	<.01**
xy5	2	66	249	156	93	9.4	<.01**
xy8	3	66	209	141	68	6.8	<.01**
yz2	1	66	y185	z157	28	2.8	<.01**
yz5	2	66	156	139	17	2.3	.05*
yz8	3	66	141	101	40	5.08	<.01**
xz2	1	66	x247	z157	90	8	<.01**
xz5	2	66	244	139	105	11.36	<.01**
xz8	3	66	209	101	108	9.53	<.01**

SOUND <i>oo</i>							
ORDER NUMBER	TRIAL	NUMBER OF PAIRS	EXPERIMENTAL	CONTROL	E - C	<i>t</i>	P
xy3	1	66	x 253	y 196	57	7.82	<.01**
xy6	2	66	234	199	35	5.3	<.01**
xy9	3	66	230	197	33	4.54	<.01**
yz3	1	66	y198	z211	-13	-1.59	.10
yz6	2	66	199	213	-14	-1.65	.10
yz9	3	66	199	194	5	.52	.70
xz3	1	66	x255	z211	44	4.86	<.01**
xz6	2	66	234	213	21	2.0	.05*
xz9	3	66	230	194	36	4.32	<.01**

** Significant at the one percent level.

* Significant at the five percent level.

ness. Statistic t is a measure of the divergence of fact from hypothesis. For example, for 30 d. f. (degrees of freedom), that is, for samples of 31 cases each t exceeds the value .127 in 90% of all random cases of this size if the hypothesis happens to be true. For the same size

TABLE III
SUMMARY OF STATISTIC t^*

	NUMBER POSSIBLE	NUMBER .01 SIGNIFICANT	NUMBER .05 SIGNIFICANT	NUMBER NOT SIGNIFICANT
xz	26	15	5	6
xy	26	14	5	7
yz	26	9	7	10
Totals	78	38	17	23

* Data secured from Table II.

TABLE IV
SUMMARY TABULATION OF SIGNIFICANT t SCORES FROM .01-.05 LEVEL
Sounds *ah*, *ee*, *oo*, in Subjects H, I, J*

.01-.05				NOT SIGNIFICANT			
SUBJECT			TOTALS	SUBJECT			TOTALS
A	B	C		A	B	C	
<i>ah</i>				<i>ah</i>			
xy	1	3	3	2	0	0	2
yz	2	2	2	1	1	1	3
xz	1	3	3	2	0	0	2
			7				7
			6				
			7				
			20				
<i>ee</i>				<i>ee</i>			
xy	1	2	3	2	1	0	3
yz	2	2	3	1	1	0	2
xz	1	3	3	2	0	0	2
			7				7
			7				
			20				
<i>oo</i>				<i>oo</i>			
xy	1	2	3	1	1	0	2
yz	2	1	0	0	2	3	5
xz	0	3	3	2	0	0	2
			6				9
			15				
xy=7	6	6	19	xy=2	3	2	7
yz=6	7	3	16	yz=3	2	5	10
xz=7	7	6	20	xz=2	2	2	6
			55				23
Totals							

* Data secured from Table II.

sample, t exceeds .253 in 80% of such samples. In order for a t to be significant at the 2% level in samples of 31 cases (d. f. = 30) it must exceed 2.457, and at the 1% level it must exceed 2.750.

Let us take an example from the data. Subject I, sound *ah* (See Table II), in the xz relationship (that is the relationship of articulating the sound *ah* with nothing in the mouth and with the high palate filled in to a normal broad palate the value of statistic t is 5.0. T is significant for 30 d. f. or more to 100 d. f. when the value exceeds 2.750 at the 1% level; so we can conclude that a t value of 5.0 would be highly significant.

$$\text{The formula for } t = \frac{M_o - M_H^{(s)}}{\sqrt{\frac{\sum d^2}{n(n-1)}}}$$

In the analysis of data it was found that

1. There is a significant difference between the trials of x , y , z .
In Table I the critical ratio between the relationships of

x and z is 17.2
 x and y is 15.2
 y and z is 5.9

In Table III it was found that 55 out of 78, or 69%, of the t values were significant for xz , xy , yz relationships.

2. In the stimuli of *ah*, *ee*, *oo*, the *ee*, in three out of four subjects, proved to have the highest t values and therefore appeared to be the hardest to articulate with the varying degrees of the palatal filling. (See Tables IV, V, VI, VII.)
3. There is a significant difference in the order of the trials. In Table VII it is found that order affects the judgment of subjects. In 4 subjects we find two instances out of a possible 105 where the judgment of the evaluators was consistent 2 times out of 3. In Subject H, sound *oo*, xz relationship, t value was 1.4 and 1.4. In Subject I, sound *ee*, xy relationship, t values were 2.1 and 2.2.
4. There is a possible significance between the judgments of sexes. (This particular factor was not followed through. It might make a complete study in itself.)
5. There is a significant difference between Subjects H, I, J, and K in adaptability to the varying degrees of the palatal filling. Subjects H and K had greater adaptability.

*Lindquist, E. F., *Statistical Analysis in Educational Research*. Houghton Mifflin Company, Boston, (1940), 51.

TABLE V
SUMMARY TABULATION OF *t* SCORES AT .01 LEVEL
for
Sounds *ah*, *ee*, *oo*, in Subjects H, I, J*

SUBJECT	SOUND <i>ah</i> (.01)	SOUND <i>ee</i> (.01)	SOUND <i>oo</i> (.01)
H	Order Number xy 1 yz 7—	Order Number xy 5 yz 5—	Order Number xy 6 yz 3
I	xy 1 xy 7 xz 1 xz 4— xz 7	yz 2 yz 8 xz 2 xz 5 xz 8	xy 9 xz 3 xz 9
J	xy 1 xy 4 yz 1 yz 4— xz 1 xz 7	xy 2 xy 5 xy 8 yz 2 yz 8 xz 2 xz 5 xz 8	xy 3 xy 6 xy 9 xz 3 xz 9
Totals	5 xy's 3 yz's 5 xz's	4 xy's 5 yz's 6 xz's	5 xy's = 14 xy's 1 yz = 9 yz's 4 xz's = 15 xz's

* Data secured from Table II.

TABLE VI
SUMMARY TABULATION OF *t* SCORES NOT SIGNIFICANT
for
Sounds *ah*, *ee*, *oo*, in Subjects H, I, J*

SUBJECT	SOUND <i>ah</i>	SOUND <i>ee</i>	SOUND <i>oo</i>
H	Order Number xy 4 xy 7 yz 1 xz 4 xz 7	Order Number xy 2 xy 8 yz 2 xz 2 xz 5	Order Number xy 3 xz 3 xz 6
I	yz 7	xy 8 yz 5	xy 6 yz 6 yz 9
J	yz 7		yz 3 yz 3 yz 6 yz 9
Totals	2 xy's 2 xz's 2 yz's 6	3 xy's 2 xz's 2 yz's 7	2 xy's = 7 xy's 2 xz's = 6 xz's 5 yz's = 9 yz's 9 15

* Data secured from Table II.

TABLE VII
EFFECT OF ORDER ON JUDGMENT AS SHOWN BY *I* SCORES

SUB- JECTS	SOUNDS	XY			YZ			XZ		
		TRIALS			TRIALS			TRIALS		
		I	II	III	I	II	III	I	II	III
H	ah	-2.9	-1.7	-.43	-.12	-2.4	-.75	2.5	.61	-.55
	ee	1.84	2.8	-.3	-1.5	-3.0	2.7	.07	.63	2.4
	oo	-1.0	3.6	No data* Available	2.9	-2.2	No data* Available	1.4	1.4	No data* Available
I	ah	5.6	2.0	3.2	2.36	-2.0	.79	5.0	-.32	3.7
	ee	2.1	2.2	.17	17.0	1.4	4.4	14.5	2.87	5.1
	oo	2.5	1.0	3.0	2.0	1.92	.4	3.4	2.44	3.0
J	ah	3.67	5.42	2.16	5.25	2.08	3.71	3.61	-3.20	1.3
	ee	7.23	9.4	6.8	8.00	11.36	9.53	2.80	2.30	5.08
	oo	7.82	5.3	4.54	4.86	2.00	4.32	-1.59	1.65	.52
K	ah	0	1.93	2.0	.3	.85	-3.3	.2	3.92	.44
	ee	7.2	5.23	4.09	-.47	1.12	2.04	2.86	4.8	.11
	oo	.76	-.117	.53	2.06	3.2	1.12	1.1	3.3	2.85

Ah, ee, and oo were articulated three times each, each time in a different order with respect to the palatal filling. In Trial I the order was *xyz* (*x*—with nothing in the mouth; *y*—with a pink wax pseudo-palate following the contour of the hard palate; *z*—with the pink wax pseudo-palate plus a palatal filling making the arch a normal broad one.)

The order of Trial II is *zyx*.

The order of Trial III is *yxz*.

* Recordings were defective; so the records were discarded.

CONCLUSIONS

1. There is a significant critical ratio between pleasantness-unpleasantness when *ah*, *ee*, *oo* are articulated without anything in the mouth and when they are articulated with a pink wax base-plate pseudo-palate or a palatal filling.
2. Data from 4 subjects with general American speech show that it is apparent that *ee* is more difficult to articulate than *ah* or *oo* when the palatal arch is changed.
3. There is a significant difference in the judgment of pleasantness-unpleasantness when the order of the degrees of the palatal filling is changed.

The author wishes to acknowledge the assistance of N.Y.A. Project No. 527 for 1940-1941, at Ohio State University.

A STUDY OF THE RESPIRATION OF FOURTEEN SPASTIC PARALYSIS CASES DURING SILENCE AND SPEECH*

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INTRODUCTION

THE experimental approach to the study of spastic paralysis lies partially within the realm of speech pathology, because of the impaired speech characteristic of the majority of such cases. Because little information as to the functioning of any part of the speech mechanism of the spastic is available, speech therapy is handicapped. Therefore, a study performed for the purpose of defining the functioning of any part of the speech apparatus should be of interest to the speech pathologist.

Lord¹ states that "children with cerebral palsy have severe motor disturbances involving arms, legs and speech mechanism. Lack of educational progress was sometimes due to inability to express intelligently, and to lack of experience due to the physical handicap."

The breathing characteristics of spastics have not been defined by scientific research. However, breathing studies have been made on other speech defectives and on normal speakers. Fletcher² has found that in silent breathing the inspiration and expiration are approximately equal, which finding is in agreement with the statement made by Travis³ that in ordinary quiet breathing the inspiratory and expiratory periods are of about equal length. According to records obtained by Fossler⁴ the I'-fraction (proportion of respiratory cycle occupied by inspiration) in ordinary quiet breathing averages about .40 — .45 and the I-fraction in speech averages .163.

* This study is a part of the program of research of the University of Minnesota Speech Clinic under the direction of Professor Bryng Bryngelson. The complete original data are on file at the Clinic. This problem was suggested by Dr. Charles Van Riper, Director of the Speech Clinic at Western State Teachers College, Kalamazoo, Michigan.

¹ Lord, E. E. *Children Handicapped by Cerebral Palsy*, Commonwealth Fund, (1937).

² Fletcher, J. M. "An Experimental Study of Stuttering." *J. Appl. Psychol.*, 25, (1914), 201-249.

³ Travis, L. E. *Speech Pathology*. D. Appleton and Company, New York, (1931), 1.

⁴ Fossler, H. R. "Disturbances in Breathing during Stuttering." *Psychol. Monog.*, 40, (1930), 1-32.

Henrikson⁵ and other investigators have noted that exhalations during speech of normal speakers were prolonged. Travis⁶ found a marked increase in duration of expiration during speech. The ratio of inspiration to expiration in normal speech is given by Fletcher⁷ as 217 to 1,000. Erika Kneisner⁸ found that the I-fraction for both abdominal and thoracic breathing of normal children was .25. Woodworth⁹ states: "The use of the air for metabolic purposes is of course continuous; the air for voice production is usually confined to expiration."

Anomalies of the breathing patterns of the spastic have been noted. Taylor and Wells¹⁰ state that defective speech is a common accompaniment of cerebral palsies, and Phelps¹¹ reports speech involvement in 60 per cent of his cases. "Speech training alone will not improve the speech as well or as rapidly as speech training in conjunction with other measures to improve other muscular action and coordination of the patient as a whole," writes Carroll.¹²

The purpose of this study is to determine whether or not breathing abnormalities characterize the spastic during silence or speech, and to determine the effect of complexity of speech upon respiration. Are there any consistent breathing patterns of the spastic which deviate from the normal? If so, do these breathing patterns show a greater deviation during speech than during silence? This study is an attempt to give some answers to questions such as these.

PROCEDURE AND SUBJECTS

The apparatus used in this study consisted of a Sumner pneumograph, a Marey tambour, and a Renshaw polygraph. The pneumograph was placed around the thorax of the subject at the level of the base of the sternum, and was attached by rubber tubing to the tambour, which was mounted on the carriage of the polygraph. The movements of the tambour were recorded by a writing lever made of a

⁵ Henrikson, E. H. "Simultaneously Recorded Breathing and Vocal Disturbances of Stutterers." *Archives of Sp.*, 1, (March, 1935), 133-149.

⁶ Travis, *op. cit.*, 3.

⁷ Fletcher, J. M. *The Problem of Stuttering*. Longmans, Green and Co., New York, (1938), 173.

⁸ Kneisner, E. *Oralism and Auralism*, Parts I and II, 11, (1932).

⁹ Woodworth, R. S. *Experimental Psychology*. Henry Holt and Co., Inc., (1938), 262-264.

¹⁰ Taylor, J. M. and Wells, W. H. *Diseases of Children*. P. Blakiston's Son and Co., Philadelphia, (1901), 576-585.

¹¹ Phelps, W. M. *J. of Med. Soc. of N. J.*, (Sept., 1937), 1-4.

¹² Carroll, R. L. "Speech Training in the Child Crippled by Spastic Paralysis." *J. Speech Disorders*, (Sept., 1937), 155-157.

tubular straw, to which was attached a tiny cone-shaped funnel forming the ink reservoir for the hypodermic needle writing point.

A signal key operated a standard writing pen on the polygraph. By means of this the experimenter recorded the beginning and end of vocalization.

Breathing records were obtained on the following activities for the fourteen subjects: (1) silent breathing; (2) silent reading, as the subject read a story; (3) whispered "ah's," which the subject repeated after the experimenter; (4) prolonged "ah"; (5) vocalized "ah's," repeated five times after the experimenter; (6) reading non-contextual material aloud; (7) reading a story aloud; and, (8) propositional speech.

The activities were selected in an attempt to answer such questions as: (1) Does the ordinary quiet breathing of spastics show peculiarities? (2) Does silent reading alter the breathing? (3) Do phonation and whispering differ in their effects on breathing? (4) What are the effects on breathing of controlled and progressive relaxation of the thorax as compared with a series of short relaxations? (5) Is the breathing pattern during the reading of contextual material different from that during reading of non-contextual material? (6) Do propositional speech and oral reading differ in their effects on breathing?

The fourteen spastic paralysis cases who served as subjects in this study were pupils attending the Michael Dowling School for Crippled Children in Minneapolis during the summer session of 1938. They ranged in age from 10 to 16. Four of the group were males and ten were females. Eleven of the subjects were diagnosed as cerebral palsy, extrapyramidal type; two as spastic diplegia; and one as spastic paraplegia. All but three had been enrolled in speech correction classes at some time and had received some help in proper breathing. The recording was done at the Dowling School. Before the records were made time was allowed for the subject to become acquainted with the experimenter and the apparatus.

Measurements were made of duration of thoracic expansion, contraction, and maintenance as recorded by the apparatus. A one millimeter rise in the polygraph record was used as the criterion of thoracic expansion and a decline of one millimeter as the criterion of thoracic contraction. Any duration of .25 second with less than one millimeter rise or fall was defined as thoracic maintenance. To determine the reliability of the experimenter's measurements, two other persons independently measured parts of several records. In one case there was perfect agreement with the experimenter in marking

delimitations between expansion and contraction on twenty-five breathing curves. With the second scorer, there was perfect agreement in 81.4 per cent of the seventy expansions and contractions measured by the scorer and the experimenter. In the thirteen measures where perfect agreement was lacking no difference was greater than .125 second.

In order to express the characteristics of the breathing of spastics for comparison with the breathing of normal speakers, I-fractions were computed. The I-fraction is defined as the duration of inspiration divided by the duration of the whole cycle, and according to Woodworth¹³ is statistically a better measure than the I/E ratio. The same formula will in this study be termed the X-fraction (expansion fraction) since the measurements made were of thoracic expansion and contraction as such, which does not necessarily always indicate inspiration and expiration.

In the computation of the X-fractions those maintenances occurring between two expansions or at the end of an expansion were included in expansion; those between two contractions or at the end of contraction were included in contraction.

DATA

Statistical analysis of the breathing records is summarized in Table I. For instance, in silent breathing the average X-fraction of the fourteen subjects was .414 with a standard deviation of .077 and a range of .293 to .534. This indicates that during silent breathing the average spastic in this group spends slightly less than half of the total breathing cycle in expansion of the thorax. Fossler's norms for

TABLE I
STATISTICAL MEASURES OF BREATHING OF FOURTEEN SPASTICS
DURING VARIOUS ACTIVITIES

ACTIVITY	AVG. X-FRAC- TION	RANGE	S.D.	% MAINT.	% M. AT END OF X	AVG. X-FRAC. MINUS M.
Silent Breathing.....	.414	2.93-.534	.077	.076	.658	.395
Silent Reading.....	.413	.261-.615	.094	.106	.609	.393
Whispered Ah's.....	.594	.367-.975	.191	.167	.565	.566
Prolonged Ah's.....	.501	.225-.977	.225	.217	.473	.452
Vocalized Ah's.....	.623	.325-.981	.168	.199	.511	.610
Rdg. Non-Contextual						
Material.....	.438	.223-.711	.146	.192	.494	.398
Rdg. Story.....	.435	.191-.626	.156	.190	.505	.392
Propositional Speech...	.458	.209-.836	.155	.185	.425	.409

¹³ Woodworth, *op. cit.*, 262.

normal speakers show that in ordinary quiet breathing the I-fraction averages about .40 to .45, which is again somewhat less than half, and which includes in its range the average X-fraction of this group of spastics.

The average percentage of time during which thoracic position was maintained during the total duration of silent breathing was .076. Sixty-six percent of this maintenance time occurred at the end of thoracic expansion.

In order to determine if the inclusion of maintenances produced any statistical artifact, X-fractions for all eight situations were computed with maintenance duration eliminated. No significant differences were found between any of these and the corresponding X-fraction computed by the other method. Reference to Table I shows that the largest difference was .049, with the average difference being .033.

Both the range and the standard deviation of the speech activities are greater than those of the silent activities, indicating greater variability for the former. Also, the percentage of maintenance is larger for the speech activities, averaging .091 for silence and .191 for speech.

Maintenances of thoracic position occur during both silent and speech breathing. According to Travis¹⁴ and Fossler¹⁵ maintenances are not characteristic of breathing curves of normal speakers. During speech activity the average X-fraction is .508, to compare with the norms for speech quoted by Fossler as .163. None of the X-fractions for any of the fourteen subjects during any of the speech activities was lower than .191.

In order to check the possibility of abdominal compensation as an explanation for the unusual amount of thoracic expansion during speech the following experimental check was performed.

Simultaneous recording of thoracic and abdominal breathing was made on seven of the fourteen subjects. Those activities in which thoracic expansion during speech had been evident were repeated, and simultaneous thoracic and abdominal breathing records were made. It was found that the mean percentage of abdominal opposition during thoracic expansion for the seven subjects was 28 per cent.

During silent breathing there was opposition to the extent of 17 per cent of the expansion time. According to Travis¹⁶ one charac-

¹⁴ Travis, *op. cit.*

¹⁵ Fossler, *op. cit.*

¹⁶ Travis, *op. cit.*

teristic of normal speakers during speech is "a fairly close correspondence between abdominal and thoracic breathing."

SUMMARY AND CONCLUSIONS

In the preceding section the data obtained from thoracic breathing records of fourteen spastic paralysis cases were presented. Can any conclusions be drawn as to breathing patterns found? Are there any consistent respiratory deviations characteristic of the spastic?

In silent breathing the average X-fraction of .414 would indicate a close approximation to the I-fraction of normal speakers found by Fossler to be between .40 and .45. However, the presence of 8 per cent maintenance during silent breathing points to a deviation from normal breathing in this respect.

In speech activities, numbering six in this study, the X-fractions ranged from .435 to .623, averaging .508, as compared with the norms for speech quoted by Fossler as .163. This indicates that during speech the thorax of the spastic is expanding an abnormal amount of time, for authorities agree that during speech of the normal speaker the length of expiration, which corresponds to thoracic contraction as measured in this study, is greatly increased.

Another indication of anomaly present in speech breathing of the spastic is the presence of thoracic maintenance in every record, averages ranging from 17 per cent to 22 per cent of the total period of respiration.

The extreme deviation from the norms of speech breathing indicates that the function of speech increases the abnormality of spastic breathing. Is it possible to go any further and postulate that the more complex the speech activity the more abnormal will be the respiration? Apparently not, from these records. The critical ratios of the differences between X-fractions of any two of the speech activities failed to be significant, being about one-twentieth of the amount required for reliable prediction. The small critical ratios were undoubtedly due partially to the small number of cases. It is quite possible that increase in the complexity of speech performance does cause greater abnormality in the breathing of spastics, but these data offer slight evidence in favor of such a view.

Knowing that speech occurs on expiration in the normal speaker, is there any way of accounting for the abnormal amount of thoracic expansion during the speech of the spastic?

Inspiration, during which time the thorax expands, is an active process; whereas expiration, during which time the thorax contracts,

is mainly a process of relaxation. The spastic's problem is one of relaxation. It seems possible to explain the large percentage of main-tenances occurring at the end of thoracic expansion by the fact that the thoracic muscles are unable to relax adequately at the end of the tensing process.

Because of the abnormal amount of thoracic expansion during speech of the spastic, simultaneous records of thoracic and abdominal breathing were obtained on seven of the subjects in an attempt to discover how speech was possible under such circumstances. The results suggested the possibility that abdominal compensation may account in part for the ability to talk while the thorax expands. There is also the possibility of compensation by expansion at other points.

Is there any explanation for the fact that more breathing abnormality is evident during speech than during silence? With the inability of the thorax to relax, in order to make speech possible the abdominal muscles compensate at times to provide the air pressure necessary for speech. This antagonistic movement of muscles which normally function synchronously may in part be responsible for the increased abnormality of the spastic's breathing during speech. Russell¹⁷ reports that the use of purely abdominal breathing in speech or in singing results in more muscle tension.

Spastic speech is characterized by lack of breath, lack of phonation, and rigidity of the speech musculature, and is often confused with stuttering. Opposition of thoracic and abdominal breathing movements in stutterers has been demonstrated by Travis,¹⁸ Steer¹⁹ and others. However, Moore²⁰ concluded that breathing abnormality in stutterers is the result and not the cause of stuttering.

Having found these characteristics, the question follows as to the practical value of the findings. The fact that breathing habits can be taught is our answer. Van Riper²¹ has found steady improvement in two spastics, as shown by breathing records and phonograph records, after intensive training in breathing. He reports speech improvement parallels improvement in breathing, as indicated by lowered vocal pitch, elimination of running out of breath, and elimination of interruption to continuity in the spastic's speech. Also, he

¹⁷ Russell, G. O. *Speech and Voice*. Macmillan Co., New York, (1931), 140-250.

¹⁸ Travis, *op. cit.*

¹⁹ Steer, M. D. "Symptomatology of Young Stutterers." *J. Speech Disorders*, 2, (1937), 3-13.

²⁰ Moore, W. E. "A Conditioned Reflex Study of Stuttering." *J. Speech Disorders*, 3, (1938), 163-183.

²¹ Personal communication with the author.

reports that such training has aided significantly in decreasing excessive muscular action throughout the body.

The practical value of this study is that some of the malfunctioning of the spastic's breathing is defined and partially explained.

CONCLUSIONS

1. The breathing of spastics deviates from that of normal speakers.
2. Speech activity increases the breathing anomalies.
3. The present data do not show that the degree of respiratory abnormality is effected by varying the complexity of speech activities.
4. There is an unusual amount of thoracic expansion during spastic speech.
5. In spastic breathing the position of the thorax is maintained during an abnormally long part of the respiratory cycle.
6. Thoracic and abdominal opposition occur during both silent and speech breathing.
7. Thoracic expansion during speech may be at least partially explained by abdominal compensation.

The field of research on spastic paralysis has only been opened. The pathology and diagnosis, as well as treatment, constitute a somewhat baffling frontier. Speech pathologists are interested in the problem of cerebral palsy as a result of the large percentage of such cases in which speech involvement is significant. Should speech training, which necessarily must include training in breathing, continue to produce results which show not only improvement in speech but also in general bodily coordination, speech pathology in her infancy will be able to make another contribution to scientific knowledge.

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